



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

**Request For Bids For Construction Services
Two-Stage Bidding Process**

Stage II
Invitation to Bid

July 7, 2005

**SEVIER VALLEY CENTER
BREAKOUT ROOMS**

SNOW SOUTH
Richfield, Utah

DFCM Project No. 05001710

Scott Prior and Associates

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM:

DFCM General Conditions dated May 25, 2005

DFCM Application and Certificate for Payment dated May 25, 2005

Technical Specifications:

Drawings:

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

INVITATION TO BID

**ONLY CONTRACTORS PREVIOUSLY SHORT-LISTED DURING STAGE I
ARE ALLOWED TO BID ON THIS PROJECT**

The State of Utah - Division of Facilities Construction and Management (DFCM) is requesting bids for the construction of the following project:

SEVIER VALLEY CENTER BREAK OUT ROOMS
SNOW SOUTH, RICHFIELD, UTAH
DFCM PROJECT NO: 05001710

This project includes the construction of four new breakout rooms in the Sevier Valley Center, including mobile walls, carpet, electrical and HVAC upgrades with minor control work. Construction cost estimate: \$91,600.

Company	Contact	Fax
• Kay General Contractors Inc	Clark Kay	(801)465-1125
• Ron New & Sons	Kevin New	(435)836-2398

The bid documents will be available on Thursday, July 7, 2005 from DFCM at 4110 State Office Building, Salt Lake City, Utah 84114, telephone (801)538-3018 and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Jeff Reddoor, Project Manager, DFCM, at (801)971-9830. No others are to be contacted regarding this project.

A **MANDATORY** pre-bid meeting and site visit will be held at 10:00 AM on Tuesday, July 12, 2005 at the Sevier Valley Center – front entrance, Richfield, Utah. All short listed prime contractors wishing to bid on this project must attend this meeting.

Bids must be submitted by 3:00 PM on Wednesday, July 20, 2005 to DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. Note: Bids must be received at 4110 State Office Building by the specified time. The contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction & Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of the State.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
SUSAN L. SMITH, CONTRACT COORDINATOR
4110 State Office Bldg., Salt Lake City, Utah 84114
Telephone: (801) 538-3260

STAGE II BIDDING PROCESS

ONLY CONTRACTORS PREVIOUSLY SHORT-LISTED DURING STAGE I ARE ALLOWED TO BID ON THIS PROJECT

1. Invitational Bid Procedures

Invitation to Bid: DFCM will notify each short-listed firm via e-mail and/or fax when a project is ready for construction services.

Bid Documents: Bidding documents including plans and specifications (if applicable) may be obtained by accessing DFCM's web page at <http://dfcm.utah.gov> or at DFCM's office 4110 State Office Building, Salt Lake City, Utah 84114.

Mandatory Pre-Bid Site Meeting: If required, the schedule contained in this document will indicate the date, time, and place of the mandatory pre-bid site meeting. At this meeting, contractors will receive additional instructions about the project and have an opportunity to ask questions about project details. If a firm fails to attend a pre-bid site meeting labeled "Mandatory" they will not be allowed to bid on the project.

Written Questions: The schedule contained in this document will indicate the deadline for submitting questions in writing to the DFCM Representative pertaining to this project.

Final Addendum: The schedule contained in this document will indicate the deadline for DFCM issuing the final addendum clarifying questions and changes to the scope of work. Contractors are responsible for obtaining and responding to information contained in the addenda.

Submitting Bids: Bids must be submitted to DFCM, 4110 State Office Building, Salt Lake City, Utah 84114 by the deadline indicated on the schedule contained in this document. Bids submitted after the deadline will not be accepted. Bids will be opened at DFCM on the date, time, and place indicated on the schedule. (Additional information pertaining to bidding is contained later in this document). It is your responsibility to allow for the time needed to park on Capitol Hill as recent construction activity has made the parking more difficult. Identification is required to enter the building.

Subcontractors List: The firm selected for the project must submit a list of all subcontractors by the deadline indicated on the schedule contained in this document. (Additional information pertaining to subcontractor lists is contained later in this document)

2. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Notice to Contractors.

3. **Bids**

Before submitting a bid, each bidder shall carefully examine the Contract Documents; shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Notice to Contractor's prior to the published deadline for the submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a bid bond form other than the DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **Note: A cashier's check cannot be used as a substitute for a bid bond.**

4. **Contract and Bond**

The Contractor's Agreement will be in the form bound in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the Contract Sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for Subcontractors will be specified in the Supplementary General Conditions.

5. **Listing of Subcontractors**

Listing of Subcontractors shall be as summarized in the “Instructions and Subcontractor’s List Form”, which are included as part of these Contract Documents. The subcontractors list shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contract for a period of up to three years.

6. **Interpretation of Drawings and Specifications**

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Representative a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by Addenda duly issued and a copy of such Addenda will be mailed or delivered to each person or entity receiving a set of documents. Neither DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

7. **Addenda**

Any Addenda issued during the time of bidding shall become part of the Contract Documents made available to the bidders for the preparation of the bid, shall be covered in the bid, and shall be made a part of the Contract.

8. **Award of Contract**

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. The DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

9. **DFCM Contractor Performance Rating**

DFCM will evaluate the performance of the Contractor. This evaluation may include comments from the User. The Contractor will have an opportunity to review and comment on the evaluation. Evaluations, including the Contractor's comments, may be considered in future selection in the evaluation of the Contractor's past performance.

10. **Licensure**

The Contractor shall comply with and require all of its Subcontractors to comply with the license laws as required by the State of Utah.

11. **Right to Reject Bids**

DFCM reserves the right to reject any or all Bids.

12. **Time is of the Essence**

The completion deadline for this project is **November 30, 2005**. Failure to meet the completion deadline may result in a poor performance rating from DFCM which may have a negative impact on your firm's ability to obtain future work with the state of Utah and may also result in liquidated damages being assessed. Time is of the essence in regard to all the requirements of the Contract Documents.

13. **Withdrawal of Bids**

Bids may be withdrawn on written request received from bidders within 24 hours after the bid opening if the contractor has made an error in preparing the bid.

14. **Product Approvals**

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed

the standards set forth in the drawings and specifications and are compatible with the intent and purpose of the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued Addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

15. **Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors**

Contractors shall respond promptly to any inquiry in writing by the DFCM to any concern of financial responsibility of the Contractor, Subcontractor or Sub-subcontractor.

16. **Debarment.**

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by the DFCM as part of the requirements for award of the Project.



PROJECT SCHEDULE
Stage II = Two-Stage Bidding Process

PROJECT NAME: SEVIER VALLEY CENTER BREAKOUT ROOMS SNOW SOUTH, RICHFIELD, UTAH DFCM PROJECT # 05001710				
Event	Day	Date	Time	Place
Stage II Bidding Documents available	Thursday	July 7, 2005	10:00 AM	DFCM, 4110 State Office Bldg, SLC, UT and DFCM web site *
Mandatory Pre-bid Site Meeting	Tuesday	July 12, 2005	10:00 AM	Sevier Valley Center – front entrance, Richfield, UT
Last Day to Submit Questions	Thursday	July 14, 2005	4:00 PM	DFCM, 4110 State Office Bldg, SLC, UT
Final Addendum Issued	Monday	July 18, 2005	4:00 PM	DFCM, 4110 State Office Bldg, SLC, UT or DFCM web site*
Prime Contractors Turn in Bid and Bid Bond / Bid Opening in DFCM Conference Room	Wednesday	July 20, 2005	3:00 PM	DFCM, 4110 State Office Bldg, SLC, UT
Subcontractors List Due	Thursday	July 21, 2005	3:00 PM	DFCM, 4110 State Office Bldg, SLC, UT
Project Completion Date	November 30, 2005			

* DFCM's web site address is <http://dfcm.utah.gov>



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

DFCM

Division of Facilities Construction and Management

BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the Request for Bids for the **SEVIER VALLEY CENTER BREAKOUT ROOMS, SNOW SOUTH, RICHFIELD, UTAH** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$_____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **November 30, 2005** after receipt of the Notice to Proceed, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$500.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

BID FORM
PAGE NO. 2

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract. The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within time set forth.

Type of Organization:

(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature

BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ _____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____.

Principal's name and address (if other than a corporation):

By: _____

Title: _____

Principal's name and address (if a corporation):

By: _____

Title: _____
(Affix Corporate Seal)

Surety's name and address:

STATE OF _____)
COUNTY OF _____) ss.

By: _____
Attorney-in-Fact (Affix Corporate Seal)

On this ____ day of _____, 20_____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20_____.

My Commission Expires: _____

Resides at: _____

Agency: _____
Agent: _____
Address: _____
Phone: _____

NOTARY PUBLIC

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and Management****INSTRUCTION AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, on the following basis:

PROJECTS UNDER \$500,000 - ALL SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE - ALL SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- Bidder must list "Self" if performing work itself.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

BIDDER LISTING 'SELF' AS PERFORMING THE WORK:

Any bidder that is properly licensed for the particular work and intends to perform that work itself in lieu of a subcontractor that would otherwise be required to be on the subcontractor list, must insert the term 'Self' for that category on the subcontractor list form. Any listing of 'Self' on the sublist form shall also include the amount allocated for that work.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM
Page No. 2

GROUND FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self"	300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: 350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS
SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**

**Division of Facilities Construction and Management****SUBCONTRACTORS LIST****PROJECT TITLE:** _____**Caution:** You must read and comply fully with instructions.

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #

We certify that:

1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed "Self" or "Special Exception" in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____

SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR DFCMS REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY DFCM. ATTACH A SECOND PAGE IF NECESSARY.

FUGITIVE DUST PLAN

The Contractor will fill out the form and file the original with the Division of Air Quality and a copy of the form with the Division of Facilities Construction & Management, prior to the issuance of any notice to proceed.

The Contractor will be fully responsible for compliance with the Fugitive Dust Control Plan, including the adequacy of the plan, any damages, fines, liability, and penalty or other action that results from noncompliance.

Utah Division of Air Quality

April 20, 1999

**GUIDANCE THAT MUST BE CONSIDERED IN DEVELOPING AND SUBMITTING A
DUST CONTROL PLAN FOR COMPLIANCE WITH R307-309-3, 4, 5, 6, 7**

Source Information:

1. Name of your operation (source): provide a name if the source is a construction site.
2. Address or location of your operation or construction site.
3. UTM coordinates or Longitude/Latitude of stationary emission points at your operation.
4. Lengths of the project, if temporary (time period).
5. Description of process (include all sources of dust and fugitive dust). Please, if necessary, use additional sheets of paper for this description. Be sure to mark it as an attachment.
6. Type of material processed or disturbed.
7. Amount of material processed (tons per year, tons per month, lbs./hr., and applicable units).

8. Destination of product (where will the material produced be used or transported, be specific, provide address or specific location), information needed for temporary relocation applicants.
9. Identify the individual who is responsible for the implementation and maintenance of fugitive dust control measures. List name(s), position(s) and telephone number(s).
10. List, and attach copies of any contract lease, liability agreement with other companies that may, or will, be responsible for dust control on site or on the project.

Description of Fugitive Dust Emission Activities
(Things to consider in addressing fugitive dust control strategies.)

1. Type of activities (drilling and blasting, road construction, development construction, earth moving and excavation, handling and hauling materials, cleaning and leveling, etc).
2. List type of equipment generating the fugitive dust.
3. Diagram the location of each activity or piece of equipment on site. Please attach the diagram.
4. Provide pictures or drawings of each activity. Include a drawing of the unpaved/paved road network used to move loads “on” and “off” property.
5. Vehicle miles travels on unpaved roads associated with the activity (average speed).
6. Type of dust emitted at each source (coal, cement, sand, soil, clay, dust, etc.)
7. Estimate the size of the release area at which the activity occurs (square miles). For haul or dirt roads include total miles of road in use during the activity.

Description of Fugitive Dust Emission Controls on Site

Control strategies must be designed to meet 20% opacity or less on site (a lesser opacity may be defined by Approval Order conditions or federal requirements such as NSPS), and control strategies must prevent exceeding 10% opacity from fugitive dust at the property boundary (site boundary) for compliance with R307-309-3.

1. Types of ongoing emission controls proposed for each activity, each piece of equipment, and haul roads.
2. Types of additional dust controls proposed for bare, exposed surfaces (chemical stabilization, synthetic cover, wind breaks, vegetative cover, etc).
3. Method of application of dust suppressant.
4. Frequency of application of dust suppressant.
5. Explain what triggers the use of a special control measure other than routine measures already in place, such as covered loads or measures covered by a permit condition (increase in opacity, high winds, citizen complaints, dry conditions, etc).
6. Explain in detail what control strategies/measures will be implemented off-hours, i.e., Saturdays/Sundays/Holidays, as well as 6 PM to 6 AM each day.

Description of Fugitive Dust Control Off-site

Prevent, to the maximum extent possible, deposition of materials, which may create fugitive dust on public and private paved roads in compliance with R307-309-5, 6, 7.

1. Types of emission controls initiated by your operation that are in place “off” property (application of water, covered loads, sweeping roads, vehicle cleaning, etc.).

2. Proposed remedial controls that will be initiated promptly if materials, which may create fugitive dust, are deposited on public and private paved roads.

Submit the Dust Control Plan to:

Executive Secretary
Utah Air Quality Board
POB 144820
15 North 1950 West
Salt Lake City, Utah 84114-4820

Phone: (801) 536-4000
FAX: (801) 536-4099

Fugitive Dust Control Plan Violation Report

When a source is found in violation of R307-309-3 or in violation of the Fugitive Dust Control Plan, the source must submit a report to the Executive Secretary within 15 days after receiving a Notice of Violation. The report must include the following information:

1. Name and address of dust source.
2. Time and duration of dust episode.
3. Meteorological conditions during the dust episode.
4. Total number and type of fugitive dust activities and dust producing equipment within each operation boundary. If no change has occurred from the existing dust control plan, the source should state that the activity/equipment is the same.
5. Fugitive dust activities or dust producing equipment that caused a violation of R-307-309-3 or the source's dust control plan.
6. Reasons for failing to control dust from the dust generating activity or equipment.
7. New and/or additional fugitive dust control strategies necessary to achieve compliance with R307-309-3, 4, 5, 6, or 7.
8. If it can not be demonstrated that the current approved Dust Control Plan can result in compliance with R307-309-3 through 7, the Dust Control Plan must be revised so as to demonstrate compliance with 307-309-3 through 7. Within 30 days of receiving a fugitive dust Notice of Violation, the source must submit the revised Plan to the Executive Secretary for review and approval.

Submit the Dust Control Plan to:

Executive Secretary	Phone: (801) 536-4000
Utah Air Quality Board	FAX: (801) 536-4099
POB 144820	
15 North 1950 West	
Salt Lake City, Utah 84114-4820	

Attachments: DFCM Form FDR R-307-309, Rule 307-309

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____
_____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____
_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ DOLLARS AND NO CENTS (\$_____.00), which is the base bid, and which sum also includes the cost of a 100%

CONTRACTOR'S AGREEMENT
PAGE NO. 2

Performance Bond and a 100% Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete within _____ (____) calendar days after the date of the Notice to Proceed. Contractor agrees to pay liquidated damages in the amount of \$_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Notice to Contractors, Instructions to Bidders/Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the

CONTRACTOR'S AGREEMENT
PAGE NO. 3

Contractor requests payment and agrees to safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

CONTRACTOR'S AGREEMENT
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IN WITNESS WHEREOF, the parties hereto have executed this Contractor's Agreement on the day and year stated hereinabove.

CONTRACTOR: _____

Signature Date

Title: _____

State of _____)
County of _____)

Please type/print name clearly

On this ____ day of _____, 20____, personally appeared before me, _____, whose identity is personally known to me (or proved to me on the basis of satisfactory evidence) and who by me duly sworn (or affirmed), did say that he (she) is the _____ (title or office) of the firm and that said document was signed by him (her) in behalf of said firm.

(SEAL)

Notary Public

My Commission Expires _____

APPROVED AS TO AVAILABILITY
OF FUNDS:

Financial Manager, Date
Division of Facilities Construction
and Management

**DIVISION OF FACILITIES
CONSTRUCTION AND MANAGEMENT**

Manager - Date
Capital _____

APPROVED AS TO FORM:
ATTORNEY GENERAL
May 25, 2005
By: Alan S. Bachman
Asst Attorney General

APPROVED FOR EXPENDITURE:

Division of Finance Date

PERFORMANCE BOND
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20_____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____ (Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____
Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20_____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General
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PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____ (Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____ Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and Management****CHANGE ORDER # _____**

CONTRACTOR: _____

AGENCY OR INSTITUTION: _____

PROJECT NAME: _____

PROJECT NUMBER: _____

CONTRACT NUMBER: _____

ARCHITECT: _____

DATE: _____

CONSTRUCTION CHANGE DIRECTIVE NO.	PROPOSAL REQUEST NO.	AMOUNT		DAYS	
		INCREASE	DECREASE	INCREASE	DECREASE

	Amount	Days	Date
ORIGINAL CONTRACT			
TOTAL PREVIOUS CHANGE ORDERS			
TOTAL THIS CHANGE ORDER			
ADJUSTED CONTRACT			

DFCM and Contractor agree that the terms, contract sum, scope of the Work and time specified in this Change Order shall constitute the full accord and satisfaction, and complete adjustment to the Contract and includes all direct and indirect costs and effects related to, incidental to, and/or reasonably implied from such change in the contract terms, sum, scope of the Work and time.

Contractor: _____

Date _____

Architect/Engineer: _____

Date _____

Agency or Institution: _____

Date _____

DFCM: _____

Date _____

Funding Verification: _____

Date _____

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

A list of items to be completed or corrected is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof.

The Contractor shall complete or correct the Work on the list of items appended hereto within _____ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$_____.

CONTRACTOR (include name of firm) by: _____ DATE

A/E by: _____ DATE

USING INSTITUTION OR AGENCY by: _____ DATE

DFCM by: _____ DATE

cc: Parties Noted
DFCM, Director

**Snow College South
Sevier Valley Center Break-Out Room
Division of Facilities Construction Management Project Number 05001710**

MECHANICAL INDEX

15000 General Mechanical Requirements
15005 Demolition
15030 Firestopping
15060 General Pipes and Fittings
15100 Valves
15140 Mechanical Supporting Devices
15190 Mechanical Identification
15195 Operation and Maintenance Manuals
15240 Mechanical Sound, Vibration and Seismic Control
15250 Mechanical Insulation
15300 Fire Protection Systems
15515 Hydronic Piping and Specialties
15545 Chemical Water Treatment
15830 Terminal Heat Transfer Units
15890 Ductwork
15910 Ductwork Accessories
15930 Air Terminal Units
15940 Air Outlets and Inlets
15955 Mechanical Control Systems
15960 Pneumatic Control Systems
15965 Electric Control Systems
15970 Direct Digital Control Systems
15995 System Commissioning, Testing, and Balancing

SECTION 15000 - GENERAL MECHANICAL REQUIREMENTS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Sections of other Divisions which relate to mechanical work apply to the work of this section. See various Sections on sitework, underfloor work, structural work, finish materials, etc.

- B. Related Sections: Refer to Electrical Requirements for Mechanical Equipment Section in Division 15 for basic electrical requirements for all mechanical equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

1.02 SUMMARY: This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 15000. It expands and supplements the requirements of Division 01000.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

1.03 DESCRIPTION OF PROJECT: The mechanical work described in these mechanical specifications is for a project located in Richfield, Utah. Design weather conditions are: 91° db, 61° wb, and winter -2°F. Altitude readings, unless otherwise noted, are for an elevation of 5,300 feet above sea level. Make adjustment to manufacturer's performance data as needed.

1.04 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

- A. Perform the mechanical work in strict accordance with the applicable provisions of the various codes ordinances and adoptions pertaining to the project location in effect on the date of invitation for bids. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.
- B. Hold and save the Owner and Architect/Engineer free and harmless from liability of any nature or kind arising from failure to comply with codes and ordinances.
- C. Secure and pay for permits necessary for the prosecution of the work under this contract. Contractor to pay all fees and include connection fees related to utility hookups. Include all sewer connection fees verifying current rate with Richfield City prior to bid.

- D. Reference Standards:

American Welding Society
International Mechanical Code/State Code
International Building Code/State Code
SMACNA Duct Design Standards
Local/State Plumbing Code
Locally enforced NFPA Codes

Local Fuel Utility Regulations
Local Power Utility Regulations
American Gas Association
ASME Codes for Pressure Vessels and Piping
ANSI B31.1 Piping

- E. Final inspection by the Architect/Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

- 1.05 DEFINITION OF PLANS AND SPECIFICATIONS: The mechanical drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and shall be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Architectural drawings shall take precedence over mechanical drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, specialties. Provide as directed by note or specification.

Examine the actual construction site prior to bidding and obtain an understanding of the conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, verify the dimensions governing the mechanical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which mechanical work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed nor allowed due to failure to report unfavorable conditions affecting the mechanical work.

- 1.06 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

- 1.07 MECHANICAL INSTALLATIONS:

- A. Coordinate mechanical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

- E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate installation of mechanical equipment and materials.
- G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, existing structures and other installations.
- J. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- K. Where mechanical work penetrates other trade work such as gypboard walls, etc., penetration shall be neatly cut and walls shall be filled and patched.

1.08 ACCESSIBILITY:

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturers recommendations for access and clearance.
- C. Access Doors - General: All items of mechanical equipment which may require adjustment, maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.
 - 1. Provide access doors in all ductwork or plenums as required to maintain fire dampers, fire smoke dampers, equipment, controls or other elements of the system. Doors shall conform to SMACNA standards unless otherwise detailed or specified.

1.09 CHANGE ORDERS: See General Conditions.

1.10 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some work methods which differ from those specified which could save time and effort. These may be presented to the Architect with a breakdown of possible cost savings for review. Implement only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.11 CUTTING AND PATCHING:

- A. Lay out the project where new work is involved ahead of time, providing sleeves and blockouts, and have work specifically formed, poured and framed to accommodate mechanical installations. Cut and patch only as needed.
- B. Refer to the Division 1 Section: CUTTING AND PATCHING for general requirements for cutting and patching.
- C. Refer to Division 16 Section: BASIC ELECTRICAL REQUIREMENTS for requirements for cutting and patching electrical equipment, components, and materials.
- D. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- E. Arrange for repairs required to restore other and any work damaged as a result of mechanical installations.
- F. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work;
 - 2. Remove and replace defective Work;
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed Work as specified for testing;
- H. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1.12 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Architect. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed. Document each transmittal and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted.

- A. Shop Drawings: As soon as possible after the contract is awarded, submit to the Architect, seven (7) copies of the descriptive literature covering all equipment and materials to be used in the installation of mechanical systems for this project. Written confirmation of acceptable review by the Owner's Representative shall be obtained before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, contained in a three-ring looseleaf binder(s) with identification tabs for each item or group of related items. Submitted literature shall clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review of the Architect/Engineer is for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions which may affect his work.

- B. Record Drawings: During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked-up documents over to the Architect/Engineer at the conclusion of the work so that the original tracings can be revised. If the Contractor fails to mark up the prints, reimburse the Architect/Engineer for time required to do so.

1.13 OPERATION AND MAINTENANCE TRAINING:

- A. Instruction Of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.
- B. Instruct building operating staff in operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual when so doing.
- C. Minimum instruction periods shall be as follows:
1. Mechanical - one hour, total.
 2. Temperature Control - one hour, total. Programming help as needed.
- D. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the DFCM Building Operation Personnel throughout the first year.
- E. None of these instructional periods shall overlap another.

- F. Vendors for each piece of equipment controls, etc., shall participate along with the Contractor(s).

- 1.14 **GUARANTEE/WARRANTY:** The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from mechanical defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of recommission." See also section 15680 **Air Cooled Chiller®** for additional warranty requirements for the chillers.

Compile and assemble the warranties required by Division 15 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

Mechanical systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

- 1.15 **TESTS AND CERTIFICATIONS:** Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

- 1.16 **PERMITS, FEES, LICENSES:** Refer to General Conditions. See Paragraph 1.04.

- 1.17 **CEILING SPACE COORDINATION:** Carefully coordinate ceiling cavity space with all trades; however, installation of mechanical equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: existing systems; new supply, return and exhaust ductwork; new heating water piping; new fire protection; new control conduit; etc. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

- 1.18 **MECHANICAL COORDINATION DRAWINGS:** For the entire building including all floor spaces, mechanical rooms, congested areas, or areas of great detail, prepare and submit a set of coordination drawings showing major elements, components and systems of mechanical equipment and materials in relationship with other building components (structure, fire sprinkler, electrical, etc.). Prepare drawings to an accurate scale of 1/4" - 1-0" or larger. Indicate the locations of all equipment and materials, including clearances for installing and maintaining equipment, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

Prepare floor plans, reflected ceiling plans, elevations, sections and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

- A. Ceiling plenums which contain piping, ductwork, or equipment in congested arrangement. To include structure, ductwork, piping, fire protection, large electrical conduit, recessed lights, etc.
- B. Numbered valve location diagrams.
- C. General floor plan layouts with ductwork, piping, lighting, structure, etc.
- D. Use drawings to coordinate all affected trades. Do not work without coordinated drawings.

- 1.19 SCHEDULING/METHODS OF PROCEDURE: Where interruptions of service are needed to effect work of this contract, outline the work, coordinate with other trades, determine the Owners acceptable downtime and prepare a time based schedule to accomplish the work. Give notice of a necessary systems or utility interruption (or shutdown) to any existing system to the owner's construction coordinator not less than 72 hours prior to the proposed shutdown. This will then be coordinated with the Campus Utility Services Department and the campus areas involved for approval to go ahead with the shutdown or re-schedule. Set up for evening, nighttime or weekend hours as necessary to accomplish the work with minimum disruption.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.01 QUALITY OF MATERIALS AND EQUIPMENT:

- A. All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions. All materials shall be produced by manufacturing plants located in the United States of America.
- B. Furnish and install all major items of equipment specified in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and all other accessories necessary for a complete and satisfactory installation.

2.02 PROTECTION OF MATERIALS AND EQUIPMENT:

- A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or mechanical injury. Plumbing fixtures intended for the final installation shall not be used by the construction forces. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.
- B. Do not make temporary use of project equipment, new or existing, during construction without the consent of the owner.

2.03 QUALIFICATIONS OF WORKMEN:

- A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.

- B. Employ no unskilled persons in the work which he is given to do; execute all work in a skillful and workmanlike manner. All persons employed upon this work shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall dismiss him and he shall not be again employed upon the work without permission of the Owner's Representative.
 - C. Welding certification - See Section 15060.
- 2.04 FOREMAN: Dedicate and designate a full-time general mechanical foreman to the Owner's Representative to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.
- 2.05 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC terminal units shall be common source. Valves, variable volume boxes, speed drives, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.
- 2.06 HANGERS AND SUPPORTS (GENERAL):
- A. Provide hangers and/or supports for all equipment, piping and ductwork. Primary information is contained in these specifications and on the drawings.
 - B. Provide hangers and supports to correlate with seismic restraint and vibration isolation.
- 2.07 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Architect who shall direct adjustments as deemed necessary and desirable.
- 2.08 ELECTRICAL WIRING AND CONTROL:
- A. In general, motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under Division 16000 of this Specification. Items of electrical control equipment specifically mentioned to be furnished by the Division 15000 either in these specifications or on the electrical or mechanical drawings, shall be furnished and mounted by this Contractor and shall be connected under and as required by this Division 15000 and Division 16000 of these specifications.
 - B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.
 - C. Division must be fully coordinated with Division 16000 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.
 - D. Where the detailed electrical work is not shown on the electrical drawings, the Mechanical Contractor shall furnish, install and wire or have prewired all specified and necessary controls for air handling equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

2.09 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Fill, clean and flush and sterilize where appropriate, all water piping systems with water and drain these systems before they are placed in operation. Blow out all other piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before grilles, outlets or mixing boxes are installed and connected.

- A. Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

2.010 JOBSITE CLEANUP:

- A. Keep site clean during progress of work.
- B. At the conclusion of work, clean all installation thoroughly.
 - 1. Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.
 - 2. Remove all debris from site.

END OF SECTION 15000

SECTION 15005 - DEMOLITION

PART I - GENERAL

1.01 SECTION INCLUDES:

- A. Remove existing mechanical systems in the remodel area of the Multi-events Center which are made obsolete by this remodel.
- B. Maintain existing installation which continues in service or is adapted
- C. Adapt existing installation to new conditions, i.e., remove and reinstall ductwork and piping which must be offset or revised to accommodate new installation, layouts, etc.

1.02 REFERENCES:

- A. Respond to General Conditions, Supplemental General Conditions, Division 1000, etc.
- B. Respond to General Requirements of Technical Divisions.

1.03 PROJECT/SITE CONDITIONS:

Work under this project is confined to specific areas in an existing building. These areas are noted on the drawings. A portion of the existing ductwork, piping and fire protection system will be modified, replaced, altered and removed. The contractor is to be familiar with existing conditions in the building. The building is to be restored to full service.

Except for the areas being remodeled, this building will be occupied with all systems serving these occupied spaces kept in service. Where temporary disruption to any system is required it shall be scheduled as noted below and in other sections of this specification. Where disruption occurs with approval ductwork, piping, fire protection ,etc. shall be immediately capped and sealed with all systems restored to the occupied spaces.. All building spaces outside of the remodel areas are considered occupied.

The drawings will indicate to the Contractor which pieces of equipment and material will be retained by the Owner. The contractor shall protect and deliver such equipment to Owners personnel.

1.04 SCHEDULING/METHODS OF PROCEDURE: Where interruptions of service are needed to effect work of this contract, outline the work, coordinate with other trades, determine the Owners acceptable downtime and prepare a time based schedule to accomplish the work. Give notice of a necessary systems interruption (or shutdown) to any existing system to the owner-s construction coordinator not less than 72 hours prior to the proposed shutdown. The Owners representative will review then give approval to go ahead with the shutdown or re-schedule. Set up for evening, nighttime or weekend hours as necessary to accomplish the work with minimum disruption.

PART II - PRODUCTS

PART III - EXECUTION

3.01 PIPING AND EQUIPMENT:

Remove all piping and equipment rendered obsolete by this work and as designated on the drawings. Dispose of removed material off-site. Identify capped ends to be able to properly restore directional flow. Value and cap active piping to insure building system function is maintained to remainder of the building.

3.02 DUCTWORK AND EQUIPMENT:

Remove all ductwork and equipment rendered obsolete by this work, and as designated on the drawings. Dispose of removed material off-site. Keep inactive openings covered and protected from damage, contamination, etc. Cap and seal active openings to insure building system functions are maintained to the remainder of the building

3.03 CONTROLS:

Remove control air piping and tubing back to main and cap. Solder air piping and plug plastic tubing. Bending over, crimping or tying is not acceptable.

END OF SECTION 15005

SECTION 15030 - MECHANICAL FIRESTOPPING

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Conditions Specification Sections, apply to this section.

1.02 SUMMARY: This section includes firestopping for the following:

- A. Penetrations through fire-resistance-rated floor construction including openings containing wires/cables, pipes, ducts, conduits, and other penetrating items.
- B. Penetrations through fire-resistance-rated walls and partitions including openings containing wires/cables, pipes, ducts, control conduits, and other penetrating items.

1.03 SYSTEM PERFORMANCE REQUIREMENTS:

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
- B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:
 - 1. Where firestop systems protect penetrations located outside of wall cavities.
 - 2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 - 3. Where firestop systems protect penetrating items larger than a 4-inch diameter nominal pipe or 16 square inch in overall cross-sectional area.
- D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- E. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic.

1.04 SUBMITTALS:

- A. General: Submit the following according to Conditions of Contract and General Conditions Specification Sections.
- B. Product data for each type of product specified.

1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- C. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- D. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE:

- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the ASystem Performance Requirements® article:
 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements.
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their AFire Resistance Directory,® by Warnock Hersey, or by another qualified testing and inspecting agency.
- B. Information on drawings referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architect's prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.
- C. Installer Qualifications: Engage an experience installer who has completed firestopping that is similar in material, design, and extent to that indicated for the project and that has performed successfully.
- D. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- E. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, APolarized Light Microscopy.®
- F. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Deliver firestopping products to project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to project; curing time; and mixing instructions for multi-component materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 PROJECT CONDITIONS:

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturer's instructions by natural means or, where this is inadequate, forced air circulation.

1.08 FIRESTOPPING - GENERAL:

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with System Performance Requirements® article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semi-refractory fiber (mineral wool) insulation.
 - 2. Ceramic fiber.
 - a. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - b. Fire-rated formboard.
 - c. Joint fillers for joint sealants.
 - 3. Temporary forming materials.
 - 4. Substrate primers.
 - 5. Collars.
 - 6. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this section that comply with system performance and other requirements.

1.09 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS:

- A. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
- B. Intumescent Putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.

- C. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.
- D. Solvent-Release-Curing Intumescent Sealant: Solvent-release-curing, single-component, synthetic-polymer-based sealant.
- E. Intumescent Metal-Faced Sheets: Single-component, intumescent sheet with 28-gauge steel bonded to one side.
- F. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Intumescent Latex Sealant:
 - a. Fire Barrier CP 25WB Caulk, 3M Fire Protection Products.
 - 2. Intumescent Putty:
 - a. Fire Barrier Moldable Putty, 3M Fire Protection Products.
 - 3. Intumescent Wrap Strips:
 - a. Fire Barrier FS-195 Wrap/Strip, 3M Fire Protection Products.
 - 4. Solvent-Release-Curing Intumescent Sealants:
 - a. Fire Barrier CP 25N/S Caulk, 3M Fire Protection Products.
 - b. Fire Barrier CP 25S/L Caulk, 3M Fire Protection Products.
 - 5. Intumescent Metal-Faced Sheets:
 - a. 3M Fire Barrier Composite Sheet CS195, 3M Fire Protection Products.

1.10 EXAMINATION:

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

1.11 PREPARATION:

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

1.12 INSTALLING THROUGH-PENETRATION FIRESTOPS:

- A. General: Comply with the ~~ASystem~~ Performance Requirements article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

1.13 CLEANING:

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION 15030

SECTION 15060 - GENERAL PIPES AND FITTINGS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 General Pipes and Fittings section, and is part of each Division-15 section making reference to pipes and pipe fittings specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.02 SUMMARY:

- A. This section is generic in that it describes material and installation required by several other sections of this specification.
- B. Types of pipes and pipe fittings specified in this section include the following:
 - 1. Steel Piping
 - 2. Copper Piping
 - 3. Cast-Iron Pressure Piping
 - 4. Cast-Iron Soil Piping
 - 5. Acid Resistant Piping
 - 6. PVDF Piping
 - 7. Grooved Joint Piping
 - 8. Miscellaneous Piping Materials/Products.
- C. Pipes and pipe fittings furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications:
 - 1. Firm with at least three years history of successful experience on projects of similar nature.
 - 2. Licensed as a firm in the contractor state of origin and in the State of Utah.
 - 3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the contractor.
 - 4. All workmen employed on the project to carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.
- C. Welding Certification:
 - 1. Each welder shall have passed a qualification test within the past six months prior to working on the project.

2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
3. The test report shall certify that the welder is qualified to weld the material to be used at the job site in the positions required (flat, vertical, overhead etc.).
4. Submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- B. Welding Certifications: Submit reports as required for piping work.
- C. Brazing Certifications: Submit reports as required for piping work.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 1.

1.05 REFERENCES:

- A. Codes And Standards:
 1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.
 2. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
 3. NSF Labels: Where plastic piping is indicated to transport potable water, provide pipes and pipe fittings bearing approval label by National Sanitation Foundation (NSF).

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART II - PRODUCTS

2.01 GENERAL:

- A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards. Use United States (domestic) manufactured pipe only. Do not use foreign made pipe.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable. Use domestic manufactured fittings only. Do not use foreign manufactured fittings.

2.02 STEEL PIPES AND PIPE FITTINGS:

- A. Black Steel Pipe: Seamless or ERW, ASTM A 53.
- B. Galvanized Steel Pipe: ASTM A 53.
- C. Galvanized Seamless Steel Pipe: ASTM A 53.
- D. Electric-Resistance-Welded Steel Pipe: ASTM A 135.
- E. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.
- F. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.
- G. Cast-Iron Threaded Fittings: ANSI B16.4.
- H. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
- I. Unions: ANSI B16.39; 300 lb. ground joint malleable iron, hexagonal, selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
- J. Dielectric Unions: 175 psig WSP at 250°F. Equal to Walter Vallet Company V-line insulating coupling.
- K. Threaded Pipe Plugs: ANSI B16.14.
- L. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
 - 1. Material Group: Group 1.1.
 - 2. End Connections: Buttwelding.
 - 3. Facings: Raised-face.
 - 4. Steel Pipe Flanges For Waterworks Service: AWWA C207.

- M. Forged-Steel and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.
- N. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.
- O. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).

2.03 COPPER TUBE AND FITTINGS:

- A. Copper Tube: ASTM B 88; Type K, L (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated. Do not use Type M for pressure piping.
- B. DWV Copper Tube: ASTM B 306.
- C. ACR Copper Tube: ASTM B 280.
- D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
- E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
- F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23.
- G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
- H. Cast-Copper Flared Tube Fittings: ANSI B16.26.
- I. Bronze Pipe Flanges/Fittings: ANSI B16.24.
- J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.04 GROOVED PIPING PRODUCTS: (Only where acceptable.)

- A. General: At Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems having operating conditions not exceeding 230°F (110°C), excluding steam piping condensing water return to pump, and any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.
- B. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature. (Victaulic style 77) For rigid joints (Victaulic "Zero Flex" style 07).
 - 1. Coupling Housings: Malleable iron conforming to ASTM A 47.
 - 2. Coupling Housings: Ductile iron conforming to ASTM A 536.
 - 3. Standard: Enamel coated, options hot dip galvanized.

- C. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.
 - 1. Water Services: EDPM Grade E, with green color code identification.
 - 2. Other Services: As recommended by Manufacturer.
- D. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.
 - 1. Exposed Locations: Tamper resistant nuts.
- E. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
- F. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.
 - 1. Malleable Iron: ASTM A 47.
 - 2. Ductile Iron: ASTM A 536.
 - 3. Fabricated Steel: ASTM A 53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".
 - 4. Steel: ASTM A 234.
- G. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.
 - 1. Malleable Iron: ASTM A 47.
 - 2. Ductile Iron: ASTM A 536.
- H. Specialties:
 - 1. Inline strainers. Victaulic Style 730.
 - 2. Suction diffusers. Victaulic Style 731.
 - 3. Dielectric couplings. Victaulic Style 47.
- I. Grooves: Conform to the following:
 - 1. Standard Steel: Square cut.
 - 2. Standard Steel: Roll grooved.
 - 3. Ductile Iron: Radius cut grooved, AWWA C606.
- J. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following:
 - 1. Anvil, Gruvlok
 - 2. Victaulic Co. of America.
 - 3. Gustin-Bacon

2.05 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
 - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements. Use **no lead** bearing solders in domestic water applications.
 - 1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
 - 2. Silver-Lead Solder: ASTM B 32, Grade 96TS.
- C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.
 - 1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
- D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.
- E. Strainers:
 - 1. Y pattern, self-cleaning, line size. Armstrong, Bailey, Crane, Fisher, Metraflex, Mueller, Sarco, Strong, or Yarway.
 - a. Iron Body, Screwed Ends 2" and Smaller: 250 psig at 425°F, screen mesh to suit service.
 - b. Flanged Iron Body 2-1/2" and Larger: 125 psig steam pressure rating, screen mesh to suit service.

PART III - EXECUTION

3.01 INSTALLATION:

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently- leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible union, flanges, etc., for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Do not cold spring. Store filler weld materials in accordance with codes.

Comply with ANSI B31 Code for Pressure Piping.

- B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated. Provide high point vents, low point drains with valves and extension to drain for all piping.
- C. All piping in mechanical rooms, fan rooms, etc., shall be exposed. Do not conceal or imbed piping in walls, floors or other structures.
- D. Make changes in direction or size with manufactured fittings. Anchor and support piping for free expansion and movement without damage to piping, equipment or to building.
- E. Arrange piping to maintain head room and keep passageways clear.
- F. Provide unions at connections to equipment and elsewhere as required to facilitate maintenance.
- G. Run full pipe size through shutoff valves, gas cocks, balancing valves, etc. Change pipe size within three pipe size diameters of final connection to equipment, coils, etc.
- H. Erect all piping to insure proper draining.
- I. On horizontal straight runs of pipe, use eccentric reducers with straight side on top for water piping.
- J. Electrical Equipment Spaces: Do not run piping in or through transformer vaults and other electrical or electronic equipment spaces and enclosures or above electrical gear unless authorized and directed. Install drip pan under piping that must be run through electrical spaces.
- K. Anytime lines are broken or disconnected they shall be capped immediately after flushing. If rocks or other foreign materials are found in the system after it has been closed, the Contractor shall stand the expense of their removal.

3.02 PIPING SYSTEM JOINTS:

- A. General: Provide joints of type indicated in each piping system.
- B. Threaded: Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- C. Brazed: Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.

- D. Soldered: Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- E. Welded:
1. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.
 2. Weld pipe joints in accordance with recognized industry practice and as follows:

Weld pipe joints only when ambient temperature is above 0°F (-18°C) where possible, with minimum pipe preheat to 50°F.
Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".

Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install regular "T" fitting.

At Installer's option, install forged branch-connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.
- F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- G. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.
- H. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.01 CLEANING, FLUSHING, INSPECTING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
1. Inspect pressure piping in accordance with procedures of ASME B31.
- B. Disinfect water mains and water service piping in accordance with AWWA C601.

- C. Flush, treat and clean heating and cooling systems in accordance with Sections chemical treatment. Certify by signature of Contractor and Owner's Representative.

3.02 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
 - 1. Required test period is 2 hours.
 - 2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are lower Class or pressure rating.
 - 3. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
 - 4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- B. Notifications: At least 10 days prior to commencement of required testing, notice shall be submitted for review. Tests shall be made prior to painting insulating or covering of any joints and shall be in accordance with ANSI Code for Pressure Piping.
- C. Inspections: Contractor to visually inspect piping while under hydrostatic pressure. Copies of inspection shall be submitted for review. At option of contract, welds not hydrostatically tested may be x-ray tested.
- D. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- E. Drain test water from piping systems after testing and repair work has been completed.
- F. Test pressure piping in accordance with ANSI B31.
- G. If test procedures in other sections differ from the above, comply with more stringent requirements.

END OF SECTION 15060

SECTION 15100 - VALVES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 Valves section, and is part of each Division-15 section making reference to valves specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.02 SUMMARY:

- A. Extent of valves required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of valves specified in section include the following:
 - 1. Drain Valves.
 - 2. Ball Valves.
 - 3. Miscellaneous Valves.
- C. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

1.03 QUALITY ASSURANCE:

- A. Manufacturer-s Qualifications: Firms regularly engaged in manufacture of valves, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Valve Types: Provide valves of same type by same manufacturer.
- C. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.
- B. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

1.05 REFERENCES:

A. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".
3. UL and FM Compliance: Provide valves used in fire protection piping, which are UL-listed and FM approved.

PART II - PRODUCTS

2.01 VALVES:

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.
- B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- C. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, 5" and smaller, other than plug valves. Provide one wrench for every 10 plug valves. Provide gear operators for quarter-turn valves 6" and larger. Provide chain-operated sheaves and chains for overhead valves 20'-0" and higher above finished floor, as directed in the field by engineer.
- D. Connections: Unless otherwise noted for a particular reason, any valve 2" and larger shall have flanges.

2.02 MANUFACTURERS: Valves shall comply with specific manufacture requirements and be of one of the manufacturers listed in specification.

- A. All valves of a given type shall be of the same manufacturer.

2.03 HOT WATER HEATING:

A. Ball Valves:

1. Steel piping 3" and Smaller: 400 psig WOG @ 350°F, bronze construction, threaded ends, bubble tight mineral filled PTFE seat at 250 psig under water, hard, chrome plated brass or stainless steel full ported ball. Operate with flow in either direction. Lever or tee hand as required. Suitable for throttling and tight shut-off. Watts B-6000, Apollo 70-100. Crane Hydro Gem 2190H. No other manufacturers approved.

B. Butterfly Valves:

1. For piping 4" and larger. Install with weld neck flanges, Norris Series R-3011-22SA-2M, double tapped lug, single-flange ductile iron or cast iron body, 316 SS disc, stainless steel shaft with extended neck for insulated pipe, EPDM seat and O-rings, 4-5" provide lever action valve with locking quadrant. Above 5" provide, indicating worm gear operator, 175 psig bubble tight pressure rating (250 where required). Centerline, Demco, Keystone, Rockwell, Grinnell, or Milwaukee.

- C. Balancing Valves: Cast brass body, chrome plated ball, PTFE seat, brass trim, integral venturi and high/low pressure taps, positive shutoff valve, memory stop and locking tamper proof setting. Do not use ball valves or butterfly valves as balance valve. Provide schedule showing pressure drop and flow rate of each valve. Flow set "Accusetter", Armstrong "CBV", Bell and Gossett "Circuit Setter Plus".

2.04 MISCELLANEOUS VALVES AND SPECIALTIES:

- A. Air Vent Valves: Stockham B-64, 300 psi working pressure, 3/8" bronze, Crane No. 88 or ball valve.
- B. Install valves with bonnets at least 45 degrees above the horizontal to ensure debris does not collect in bonnet.

PART III - INSTALLATION

2.01 VALVE INSTALLATION:

- A. Locate all valves in locations which will allow easy operation and facilitate maintenance.
- B. Install valves with stems horizontal or above.
- C. All branch lines which supply a specific area of the building shall be valved near the main so that each area may be isolated from the system for repairs without having to shut down both men and women-s restrooms, other areas, or the whole building.
- D. Make all valves located above a non-lay-in type ceiling or behind a wall accessible by means of an access door.

END OF SECTION 15100

SECTION 15140 - MECHANICAL SUPPORTING DEVICES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 Mechanical Supporting Devices section, and is part of each Division-15 section making reference to supports and anchors specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.02 SUMMARY:

- A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of supports and anchors specified in this section include the following:
 - 1. Horizontal-Piping Hangers and Supports.
 - 2. Vertical-Piping Clamps.
 - 3. Hanger-Rod Attachments.
 - 4. Building Attachments and In-Beds.
 - 5. Saddles and Shields.
 - 6. Miscellaneous Materials.
 - 7. Anchors.
 - 8. Equipment Supports.
- C. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.
- D. Relate this section to Section 15240 regarding seismic and vibration control.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.
- B. Shop Drawings:
 - 1. Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.05 REFERENCES:

A. Codes and Standards:

1. Code Compliance: Comply with applicable building, mechanical and plumbing codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
3. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
 - b. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - d. Terminology used in this section is defined in MSS SP-90.

PART II - PRODUCTS

2.01 HORIZONTAL-PIPING HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory- fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Adjustable Steel Clevises Hangers: MSS Type 1. (For suspension of non-insulated or insulated stationary pipe lines; 1/2" to 30".)
- C. Steel Double Bolt Pipe Clamps: MSS Type 3. (For suspension of pipe requiring up to 4" of insulation and where flexibility of clamp is desirable; 3/4" to 24".)
- D. Steel Pipe Clamps: MSS Type 4. (For suspension of cold pipe lines or hot lines where little or no insulation is required; 1/2" to 24".)
- E. Pipe Hangers: MSS Type 5. (For suspension of piping when off-center closure allowing installation of hanger before erection of piping is desired; 1/2" to 4".)
- F. Adjustable Swivel Pipe Rings: MSS Type 6. (For suspension of non-insulated stationary pipe lines; 3/4" to 8".)
- G. Adjustable Steel Band Hangers: MSS Type 7. (For suspension of non-insulated stationary pipe lines; 3/4" to 8".)
- H. Adjustable Band Hangers: MSS Type 9. (For suspension of non-insulated stationary pipe liens; 1/2" to 8".)

- I. Adjustable Swivel Rings, Band Type: MSS Type 10. (For suspension of non-insulated stationary pipe lines; 3/8" to 8".)
- J. Split Pipe Rings: MSS Type 11. (For suspension of non-insulated stationary pipe lines; 3/8" to 3".)
- K. Extension Split Pipe Clamps: MSS Type 12. (For suspension of non-insulated stationary pipe lines; 3/8" to 3".)
- L. U-Bolts: MSS Type 24. (For support of heavy loads; 1/2" to 30".)
- M. Clips: MSS Type 26. (For support of uninsulated piping not subject to expansion or contraction.)
- N. Pipe Saddle Supports: MSS Type 36, including steel pipe base- support and cast-iron floor flange. (To support pipe from floor stanchion, using floor flange to secure stanchion to floor 4" to 36".)
- O. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange. (To Type 36 except U-bolt provided for retaining pipe.)

2.02 VERTICAL-PIPING CLAMPS:

- A. General: Except as otherwise indicated, provide factory- fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8. (For support and steadying of pipe risers; 3/4" to 20". Also supports pipe covering or insulation.)
- C. Four-Bolt Riser Clamps: MSS Type 42. (When longer ends are required for riser clamps.)

2.03 HANGER-ROD ATTACHMENTS:

- A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13. (For adjustment up to 6" for heavy loads.)
- C. Steel Clevises: MSS Type 14. (For use on high temperature piping installations.)
- D. Swivel Turnbuckles: MSS Type 15. (For use with split pipe rings, MSS type 11.)
- E. Malleable Iron Sockets: MSS Type 16. (For attaching hanger rod to various types of building attachments.)

2.04 BUILDING ATTACHMENTS AND IN-BEDS:

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Concrete Inserts: MSS Type 18. (For upper attachment for suspending pipe hangers from concrete ceiling.)
- C. Top Beam C-Clamp: MSS Type 19. (Use under roof installations with bar joist construction, for attachment to top flange of structural shape.)
- D. Side Beam or Channel Clamps: MSS Type 20. (For attachment to bottom flange of beams, channels, or angles.)
- E. Center Beam Clamps: MSS Type 21. (For attachment to center of bottom flange of beams.)
- F. Welded Beam Attachments: MSS Type 22. (For attachment to bottom of beams where loads are considerable and rod sizes are large.)
- G. C-Clamps: MS Type 23. (For attachment to structural shapes.)
- H. Top Beam Clamps: MSS Type 25. (For attachment to top of beams when hanger rod is required tangent to edge of flange.)
- I. Side Beam Clamps: MSS Type 27. (For attachment to bottom of steel I-beams.)
- J. Steel Beam Clamps with Eye Nut: MSS Type 28. (Same as Type 28 with link extensions.)
- K. Linked Steel Clamps with Eye Nut: MSS Type 29. (Same as Type 28 with link extensions.)
- L. Malleable Beam Clamps: MSS Type 30. (For attachment to structural steel.)
- M. Steel Brackets: One of the following for indicated loading:
 - 1. Light Duty: MSS Type 31, to 570 pounds.
 - 2. Medium Duty: MSS Type 32, to 1,500 pounds.
 - 3. Heavy Duty: MSS Type 33, to 3,000 pounds.
- N. Side Beam Brackets: MSS Type 34. (For use on sides of steel or wooden beams.)
- O. Plate Lugs: MSS Type 57. (For attachment to steel beams where flexibility at the beam is desired.)
- P. Horizontal Travelers: MSS Type 58. (For supporting piping systems subject to linear horizontal movements where head room is limited.
- Q. Refer to drawings for Unistrut inserts.

2.05 SADDLES AND SHIELDS:

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; see section Mechanical Insulation for void fill requirements. Use for roller supports and on all pipes 10" and larger.
- C. Protection Shields: See section Mechanical Insulation.
- D. Thermal Hanger Shields: See section Mechanical Insulation.
- E. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:
 - 1. Elcen Metal Products Co.
 - 2. Pipe Shields, Inc.

2.06 MANUFACTURERS OF HANGERS AND SUPPORTS:

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
 - 1. Kin-Line, Inc.
 - 2. Fee & Mason Mfg. Co.; Div. Figgie International
 - 3. ITT Grinnel Corp.
 - 4. B-Line
 - 5. Unistrut

2.07 HIGH HUMIDITY AREAS: Use cadmium plated or galvanized hangers, attachments, rods, nuts, bolts and other accessories in boiler rooms or other high humidity areas.

2.08 OUTSIDE AREAS: Use galvanized hangers, attachments, rods, nuts, bolts and other accessories for all outside areas.

2.09 MISCELLANEOUS MATERIALS:

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. Use Embeco grout for non-shrink applications.
- D. Heavy Duty Steel Trapezes: Fabricate from factory built channel (Unistrut) system and use factory fasteners for channel steel shapes, selected for loads required; weld steel in accordance with AWS standards.

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION:

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS:

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS:

- A. General: Install hangers, supports, clamps and attachments to rigidly support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by isolating with foam rubber covering or 30 mil insulating tape.

D. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
2. Install supports within 2 feet of non-vertical flex connectors.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Do not allow hangers to come in contact with pipe where pipe is specified to be insulated.

H. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

I. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized steel protective shields. Install calcium silicate blocks (12" long minimum) at support points.

J. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.05 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.06 ADJUSTING AND CLEANING:

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15140

SECTION 15190 - MECHANICAL IDENTIFICATION

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. Division 15 Basic Mechanical Materials and Methods sections apply to work of this section.
- C. Cross reference Division 9 for basic painting requirements. Use this section to identify extent of painting for pipes, ducts, etc. and color coded identification.

1.02 SUMMARY:

- A. All plumbing, heating, air conditioning, automatic temperature control equipment (excluding thermostats and relays), and distribution systems shall be labeled. Include all fire damper, fire/smoke damper and smoke dampers. Electrical switches and starters for mechanical equipment shall also be labeled.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.01 EQUIPMENT, VALVE PIPE AND DUCT IDENTIFICATION:

A. Equipment Identification:

- 1. Identify all equipment including, but not limited to ATC panels, controller, etc., and all other devices shall be identified with signs made of laminated plastic with 1/8" or larger engraved letters.
- 2. Each equipment shall have its own unique equipment number.
- 3. Information on sign shall include name of equipment, identification on plans and schedules, rating, maintenance instructions and any other important data not included on factory attached name plate.
- 4. Signs shall be attached to equipment so they can be easily read. Attachment shall be by rust proof screws or rivets. Glue shall not be used.

a. AATC Panel A@

(Note: Avoid using only the engineer's designations as used on plans; identify equipment as to area or zone served.)

B. Valve Tagging:

- 1. All valves shall be designated by distinguishing numbers and letters on required charts and diagrams. The Contractor shall furnish and install approved brass tags for all designated items, with numbers and letters on the tags corresponding to those on the charts and diagrams.

2. Valve Identification:

- a. All valves, regardless of size, shall have brass tags at least 1" by 3" in size and 0.051 inches thick. Legend on tag shall use engraved lettering at least 1/8" high. Each valve on the drawing shall be identified separately, and valve tags shall match the drawing identification.
- b. Valve tags shall include the following minimum information:
 - (1) Plan Identification
 - (2) Normal Position
 - (3) Duty
 - (4) Area Served
 - (5) Valve Type
- c. Tags shall be securely fastened to valves with steel rings or brass jack chain, in a manner to permit easy reading. Do not attach to valve wheel or the handle.

3. A chart of all valves shall be furnished as part of O & M Manual by the Contractor. Charts shall indicate the following items:

- a. Valve identification number
Location
Service or purpose
Normal position
- b. One chart to be mounted in a frame with clear lexan front, and secured on a wall in the equipment room(s), or in a location as otherwise directed by the Architect.
- c. Another chart shall be prepared for use outside of the equipment room, and to be provided with an approved heavy transparent plastic closure for permanent protection. Two (2) holes to be punched at top of plastic closure to allow for affixing approximately an 811 length of nickel plated bead chain. Each hole to be reinforced by means of a small brass or nickel grommet. Plastic closure shall be as manufactured by Seton Name Plant Company, New Haven, Connecticut or equal.

4. Sample Identification Chart is as follows:

VALVE IDENTIFICATION CHART

<u>Number</u>	<u>Description</u>	<u>Location*</u>	<u>Normal Position</u>
1.	Heating Water Shutoff Above Ceiling	Room XX	Open
2.	Heating Hot Water Balancing Above Ceiling	Room XX	Open

* The above room numbers shall be the room numbers actually used. DO NOT USE ARCHITECTURAL ROOM NUMBERS ON PLANS. Use institution actual assigned room numbers.

C. Duct Identification:

1. Ductwork shall be identified at or near the fan, with stenciled signs or by engraved laminated plastic signs secured with rust proof screws. Sign shall indicate area served.
2. Identify all ducts exposed in mechanical equipment room. A sample duct identification shall be as follows: ASupply Hot Duct-Heating Auditorium Wing.®
3. Identify all fire and fire/smoke dampers, stencil designation on damper access doors.

D. Pipe Identification:

1. All pipes are to be labeled and color coded with contents clearly identified and arrows indicating direction of flow. This applies to piping run above the ceilings as well as pipe exposed in equipment rooms and finished areas. Pipes shall be identified at the following locations:
 - a. Adjacent to each valve
 - b. At every point of entry and exit where piping passes through a wall or floor.
 - c. On each riser and junction.
 - d. A maximum of every 50 feet on long continuous lines fully exposed to view. Less spacing if one cannot see one code from the adjacent.
 - e. Adjacent to all special fittings or devices (regulating valves, etc.)
 - f. Connection to equipment.
2. Apply markers so they can be read from floor. Labels and markers shall be of the self-sticking, all temperature, permanent type as manufactured by W. H. Brady Co., 727 West Glendale Avenue, Milwaukee, Wisconsin; or Seton Name Plate Corp., 592 Boulevard, New Haven, Connecticut.
3. Identifying lettering shall be painted or stenciled on duct or pipe. Self-adhesive or glue-on type labels are acceptable. Letters shall be 2" high for duct and larger piping 3" or more, 1" high for 1-1/4" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.
4. Arrows to indicate direction of flow shall be painted in the same color as the lettering. The arrow shall point away from the lettering. On duct and large piping 3" or more in diameter, the shaft of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be in either direction.
5. Pipe color coding shall be uniform throughout. Background colors shall be as follows:
 - a. Yellow: Dangerous Materials (high pressure steam, natural gas, condensate, high pressure refrigerant, high voltage, etc.)
 - b. Red: Fire Protection Equipment (fire sprinkler water, fire protection water).

- c. Bright Blue: Protective Materials (filtered water).
- d. Green: Safe Materials (chilled water, cold water, instrument air, sanitary sewer, etc.)

6. Piping and duct shall be identified with the following colors:

<u>Medium in Pipe or Duct</u>	<u>Banding Color</u>	<u>Identifying Lettering</u>	<u>Abbreviation & Lettering Color</u>
Fire Protection Water	Red	Fire Protection	Fire Black
Heating Water Supply (Bldg. Heat)	One Yellow	Heating Water Supply	HWS Black
Heating Water Return (Bldg. Heat)	Two Yellow	Heating Water Return	HWR Black
Cold Air Duct			Cold Air Duct (Unit Served)
Return Air Duct			Return Air Duct (Unit Served)
Exhaust Air Duct			Exhaust Air Duct (Unit Served)
Supply Duct			Supply Duct (Unit Served)

7. Markers shall be installed in strict accordance with manufacturer's instructions.

On chalky and loose insulation, soft, porous, fiberfilled or fiberglass coverings, a spiral wrap of pipe banding tape shall be made around the circumference of the pipe. Sufficient spiral wraps shall be made to accommodate the horizontal dimension of the pipe marker.

On bare pipes, painted pipes, and pipes insulated with a firm covering pipe banding tape matching the background color of the marker shall be used for 360 color coding. After applying pipe markers, wrap pipe banding tape around pipe at each end of marker. Tape should cover 1/4" to 1/2" to 1" on itself. Be sure pipe surface is dry and free of dirt or grease before applying markers or bonding tape.

8. Stenciling may be used in lieu of the above labels and markers if finished application gives the same overall appearance. If stenciling is used, letter heights, background colors, banding and arrows shall be as specified above. Submit samples before proceeding with work.

2.02 PANEL IDENTIFICATION:

- A. All panel devices shall have engraved black face formica with white engraved lettering labels on panel faces.

- B. All internal panel components shall have engraved black face formica labels with white engraved lettering. Fasten label beneath each device.
- C. All panel wiring and tubing shall be numerically or alphabetically coded.

END OF SECTION 15190

SECTION 15195 - OPERATION AND MAINTENANCE MANUALS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.02 SUMMARY:

- A. Furnish four sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.03 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS:

- A. General:
 - 1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.
 - 2. The mechanical contractor has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the contractor for installation.
 - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.02A.
 - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART II - MATERIALS AND METHODS

2.01 PAGE SIZE: All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 16 x 11 inches) folded to 8-1/2 x 11 inch.

2.02 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manilla pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manilla pocket.

2.03 BINDERS: Provide a binder for each operation and maintenance manual.

- A. Place the following information on the front cover:
 - 1. "Operation and Maintenance Manual".
 - 2. Project Name (and volume number if more than one volume).
Project Number (Per DFCM project number).
 - 3. Building name and phone number.
 - 4. Architect's name.
 - 5. Engineer's name.
 - 6. General Contractor's name.
 - 7. Mechanical Contractor's name.

Items 5 through 7 need not be printed on the backbone.

2.04 CONTENTS AND INDEXING:

- A. The first section shall include the following information.
 - 1. First page shall be a Table of Contents and Name of project, DFCM project number, date awarded, date of substantial completion.
 - 2. Name, addresses and phone numbers of architects engineers and associates.
 - 3. Names addresses and phone numbers of contractors and subcontractors and sub-contractors and the work to which each was assigned.
 - 4. An equipment list with the names, addresses and phone numbers of suppliers. Each piece of equipment shall be described by name, identification number, location, and function.
- B. The second section shall include the following information.
 - 1. Operating systems description to describe operating modes with single-line diagrams; all setpoints and normal operating parameters for all load, pressure temperature and flow checkpoints; all alarms and cautions for operations.
 - 2. Schematic control diagrams (blue line prints) for each VAVR box. Each control diagram shall show a schematic representation of mechanical equipment, thermostats, and automatic valves. The correct operating reading for each control instrument shall be marked on this diagram.
- C. The third section shall include the following information.
 - 1. A comprehensive lubrication and maintenance schedule for all the equipment.
- D. The Fourth section shall include the following information.
 - 1. Test run and balancing reports which include the following.

- a. Floor plans with all air openings and thermostat locations clearly marked and cross-referenced with data sheets. Format may be 8-1/2 x 11 or 11 x 14 if legible.
 - b. Data sheets showing amount of air at each opening.
- E. In following sections, devote each section to an individual piece of equipment and provide the following.
 - 1. Copy of purchase order change (if any).
 - 2. Equipment descriptions.
 - 3. Detailed installation, operating and maintenance instructions (not just a product catalog) written in a step-by-step manner of identifying start-up, operating, shutdown and emergency action sequences sufficiently clear so a person unfamiliar with that equipment could perform its operations.
 - 4. Equipment drawings, Manufacturer's test or calculated performance data and certified test curves.
 - 5. Name, address and phone number of manufacturer fabricator and local vendor.
 - 6. Complete parts listing which include catalog number, serial number, contract number, model number, size and plan symbol, or other accurate provision for ordering replacement and spare parts.
 - 7. Certified drawings where applicable, showing assembly of parts and general dimensions.
 - 8. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
 - 9. A copy of the approved submittals for each piece of equipment.
 - 10. Wiring diagrams, marked with model and size and plan symbol.
 - 11. Outline drawings, special construction details, "as built" electrical wiring and control diagrams for all major and supplementary systems.
- F. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required
- G. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
- H. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment.

END OF SECTION 15195

SECTION 15240 - MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART I - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 Mechanical Sound, Vibration and Seismic Control section, and is part of each Division-15 section making reference to mechanical sound, vibration and seismic control specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.02 SUMMARY: Furnish and install complete seismic restraint and vibration control systems for all work installed under Division 15. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective site classifications, seismic use group and component importance factor.

1.03 QUALITY ASSURANCE:

- A. ~~Manufacturers~~ Qualifications: Engage the services of an independent seismic and vibration control subcontractor who has the technology, experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein. Select from the following:
 - 1. Amber Booth
 - 2. Kinetics
 - 3. Mason
- B. The seismic and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.
 - 1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.
 - 2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the seismic restraint and vibration isolation device installation and preparing certification of the seismic vibration-isolation work.
- C. The seismic subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division 15) Contractor concerning:
 - 1. Anchoring of all mechanical equipment.
 - 2. Bracing and anchoring of ductwork piping and conduit.
 - 3. Provision for expansion and vibration of piping.

- D. The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

1.04 SUBMITTALS:

- A. Submittal data is required and shall consist of computations, anchor bolt sizes, supports, seismic restraints, restraint locations and type of restraints.
- B. Submittal data shall identify dimensions, load deflection data, standard connections, manufacturer's recommendations, associated with equipment, ductwork, piping and conduit.
- C. Calculations need not be submitted when restraint devices for piping, conduit and ductwork are proposed in accordance with the SMACNA Guidelines for Seismic Restraints.
- D. Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.
- E. Calculations furnished for anchors, anchor bolts, sole plates and other support steel for restraining devices shall be signed and stamped by an engineer licensed in one of the United States.

1.05 REFERENCES:

- A. Codes and Standards: (Latest adopted edition)

International Building Code
NFPA bulletin 90A,
UL Standard 181

Guidelines for seismic restraint of Mechanical Systems and Plumbing Piping Systems.
Published by the Sheet Metal Industry Fund of Los Angeles, California, and the
Plumbing and Piping Industry Council, Inc., Los Angeles, California.

PART II - PRODUCTS:

- 2.01 MATERIALS - PRODUCTS: Restraint devices shall be especially designed to resist seismic forces in all directions.

- A. Piping, Conduit and Duct Restraints: Restraint materials for exposed installation shall be standard fabricated flat steel, angle rod and channel members.

Restraint members shall be bolt connected. Cabling materials and methods shall be used only in chases or concealed ceiling spaces.

PART III - EXECUTION

- 3.01 SEISMIC RESTRAINT GUIDELINE:

Guidelines for SMACNA seismic restraints for conduit, piping and ductwork are to serve as the basis for restraint methods. (Exception - no cabling shall be used in the restraint systems except as noted.)

3.02 SEISMIC RESTRAINT-PIPING AND CONDUIT:

- A. General: All piping and conduit shall be protected in all planes by restraints, designed to accommodate thermal movement while at the same time restraining seismic motion.
- B. Locations of the restraints shall include, but not be limited to:
 - 1. At all drops or risers to equipment connections.
 - 2. At all changes in direction of piping and conduit.
 - 3. At all horizontal runs of pipe and conduit to keep it in alignment and prevent sagging with restraints not to exceed the following:

Transverse bracing at 40'-0" O.C. maximum.
Longitudinal bracing at 80'-0" O.C. maximum.
 - 4. Piping supported by trapeze hangers may be tied to the trapeze with seismic bracing at the trapeze.
Provide flexibility in joints where pipes pass through building seismic or expansion joints.
 - 5. On both sides of flexible connectors.
- C. Exceptions:
 - 1. Conduit under 2-1/2" size and piping under 1-1/2" size need not be additionally seismically restrained except as follows:
 - a. Brace all piping and conduit 1-1/4" and larger in boiler rooms, mechanical rooms, electrical equipment rooms and refrigeration machinery rooms.
 - b. Brace all fuel gas and oil piping, medical gas piping and compressed air piping 1" and larger.
 - 2. Seismic bracing may be omitted:
 - a. When the top of the pipe is suspended 12" or less from the supporting structure member and the pipe or conduit is suspended by an individual hanger.
 - b. On all piping 3/4" and smaller.

3.03 SEISMIC RESTRAINT INSULATED PIPING: Where piping is designated to be insulated, the points of support shall be protected by a 360° sheet metal shield. Insert insulation shall be of the same thickness as the adjoining pipe insulation. (Pipe Shields, Inc.)

The sheet metal shield wrapped around the insert shall be of the following lengths and gauge thickness.

<u>PIPE SIZE</u>	<u>SHIELD LENGTH</u>	<u>MINIMUM GAUGE</u>
1/2 - 1-1/2"	4"	20
2 - 6"	6"	20

3.04 SEISMIC RESTRAINT - PIPING AT FIRE-WALL AND FLOOR PENETRATION WHERE WALL IS USED AS A RESTRAINT:

- A. Bare Pipe: Encase pipe in minimum 24 gauge sheet metal can sized for one inch spacing between pipe and outer diameter of can. Spacing shall be packed in accordance with fire resistant/retardant materials in accordance with Section: FIRE STOPPING.
- B. Insulated Pipe: Encase in adjustable or fixed length cans, minimum 24 gauge, sized for maximum one inch spacing between insulation and outer diameter of can. Insulation shall consist of 360° insert sized to extend a minimum of 1" beyond wall or floor penetration and of the same thickness as the adjoining insulation. Spacing between shield and can shall be packed in accordance with Section: FIRE STOPPING.

3.05 SEISMIC RESTRAINT GROOVED PIPING:

- A. Where grooved piping is selected as the piping system, it must be seismically restrained as well as provide for thermal movement.
- B. Pipes may not be fastened to differently moving structures such as a wall or a ceiling, or a ceiling and a floor. The intent is to have the piping system move with the structure and not separate from it.
- C. In general, grooved piping shall be provided with additional flexible couplings to allow extreme deflections to occur, yet restrained to prevent movement beyond the limits of the flexible connections. Linear movement shall be incorporated as a part of the flexible connections or in a swing joint arrangement.
- D. Groove piping systems shall be separated, analyzed and submitted from threaded or welded piping systems.

3.06 SEISMIC RESTRAINT - DUCTWORK:

- A. Ductwork, four feet square and larger in cross sectional area or 26" diameter and larger shall be protected in all places by restraints. Locations shall include, but not be limited to:
 1. At all equipment connections.
 2. At all duct turns and duct run ends (transverse bracing).
 3. Transverse bracing to occur 30'-0" O.C. maximum. Rectangular ducts 61" and larger in either direction may be braced at 32'-0" O.C.
 4. Longitudinal bracing shall occur at 60'-0" O.C. maximum.

- B. A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of restraint members.
- C. No bracing is required if the top of the duct is suspended 12" or less from supporting member and attached at the top of the duct as well as sides and bottom.

3.07 VIBRATION ISOLATION - DUCTWORK AND PIPING:

- A. Furnish and install devices to isolate all piping and ductwork from other moving equipment. Provide flex connections, spring hangers, grooved joint couplings for pipe, etc., as required.

END OF SECTION 15240

SECTION 15250 - MECHANICAL INSULATION

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.
- B. Division-15, Section 15000 - General Mechanical Requirements applies to work of this section.

1.02 SUMMARY:

- A. Extent of mechanical insulation required by this section is indicated on drawings and schedules as required by the current Model Energy Code, and by requirements of this section. Use no asbestos in this work. Include restorations of insulations of damaged work including repair of damaged existing insulation due to new work.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping Systems Insulation:
 - a. Fiberglass.
 - b. Flexible Unicellar.
 - 2. Ductwork System Insulation:
 - a. Fiberglass.
 - b. Rigid flexible wrap.
 - c. Fireproofing for grease laden exhaust ductwork.
 - 3. Equipment Insulation:
 - a. Fiberglass.
 - b. Cellular Glass.
 - c. Flexible Unicellular.
- C. Refer to Division-15 section "Mechanical Supporting Devices" for protection saddles, protection shields, and thermal hanger shields.
- D. Refer to Division-15 section "Ductwork" for duct linings.
- E. Refer to Division-15 section "System Identification" for installation of identification devices for piping, ductwork, and equipment.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

- C. **Flame/Smoke Ratings:** Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.04 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. **Maintenance Data:** Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.
- B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. **Manufacturer:** Subject to compliance with requirements, provide mechanical insulation materials of one of the following (except as noted):
 - 1. Armstrong World Industries, Inc.
 - 2. Babcock and Wilcox Co., Insulating Products Div.
 - 3. CertainTeed Corp.
 - 4. Knauf Fiber Glass GmbH.
 - 5. Manville Products Corp.
 - 6. Owens-Corning Fiberglass Corp.
 - 7. Pittsburgh Corning Corp.

2.02 PIPING INSULATION MATERIALS:

- A. **Preformed Fiberglass Piping Insulation:** ASTM C 547. Class 1 for use to 450°F (230°C); Class 2 for use to 650°F (345°C); Class 3 for use to 1200°F (650°C).
- B. **Cellular Glass Piping Insulation:** ASTM C 552. Type I - flat block; Type II - pipe and tubing insulation, Class 1 - regular (uncovered), Class 2 - jacketed; Type III - special shapes; Type IV roof board.
- C. **Jackets for Piping Insulation:** All purpose (ASJ) fire retardant jacket, ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
- D. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

- E. Insulation Protection Shields: MSS Type 40; Complying with the following table.

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2" to 1-1/2"	4"	20 ga.
2" to 6"	6"	20 ga.

- F. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- G. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
- H. Insulation Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
- I. Thermal Hanger Shields: constructed of 360 degrees insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 degrees sheet metal shield. Provide assembly of same thickness as adjoining insulation.
1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:
 - a. Elcen Metal Products Co.
 - b. Pipe Shields, Inc.

2.03 DUCTWORK INSULATION MATERIALS:

- A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1. (Class 1 - 400°F (204°C); Class 2 - 400°F (204°C); Class 3 - 850°F (454°C); Class 4 - 1000°F (538°C); Class 5 - 1800°F (982°C); Class 1 - 10 lbs/ft³; Class 2, 3 and 4 - 12 lbs/ft³; class 5 - 20 lbs/ft³.)
- B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4. (Type 1 - resilient, flexible; Class B-1 - 0.65 lbs/ft³; Class B-2 - 0.75 lbs/ft³; Class B-3 - 01.0 lbs/ft³; Class B-4 - 1.5 lbs/ft³; Class B-5 - 2.0 lbs/ft³; Class B-6 - 3.0 lbs/ft³; Type II - flexible; Class F-1 - 4.5 lbs/ft³; Type III - semirigid; Class F-2 - 4.5 lbs/ft³.)
- C. Calcium Silicate Duct Insulation: ASTM C553, Type I, block or preformed sections. Rated assembly for greasehood exhaust duct enclosure.
- D. Thermal Ceramics AFire Master@Ductwrap: rated assembly for grease hood exhaust duct enclosure
- E. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.
- F. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- G. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.01 PIPING SEALANT THROUGH WALLS:

- A. Sealant shall be a two-part foamed silicone elastomer equal to Dow Corning 3-6548 Silicone RTV foam or equivalent by 3M or ASpec Seal® by STI. Sealant shall be applied at any piping of pipe or duct penetration through fire or smoke walls to prevent air from passing through the opening.
- B. Sealant cell structure, foamed in place, shall be U.L. classified and shall meet the smoke development and fuel contribution ratings specified. Sealant shall be stable at extreme temperatures, and shall effectively confine such hazards as fire, smoke and gases.
- C. Sealant required at any fire/smoke wall penetration to be according to approved detail for each specific wall assembly. Contractor shall submit detail for engineer approval.

2.02 PIPE JACKETING:

- A. Provide and install jacketing for all exposed insulated pipe in corridors. This in addition to standard foil on Kraft jacketing (ASJ).
 - 1. Heating water, other insulated piping.
 - PVC sheets, 0.030" thickness.
 - PVC formed fitting covers.
 - Solvent welded joints and seams.
 - (Provide for removal and expansion.)
- B. All joints and seams caulked and sealed water tight.
- C. Color of jacketing to be white.

PART III - EXECUTION

3.01 GENERAL:

- A. Piping insulation shall be fiberglass one-piece preformed pipe insulation, class related to temperature, with all purpose (ASJ) fire retardant jacket, additional jacketing as noted.
- B. Fittings and valves shall be insulated and covered with preferred Zeston (PVC) covers.
- C. All cold water, chilled water, roof drains or any other lines upon which condensate moisture could form, shall have a vapor-proof jacket.
- D. Fire and smoke hazard for a complete insulation system shall not exceed:
 - 1. Flame spread - 25
 - 2. Fuel contribution - 50
 - 3. Smoke development - 50
- E. Hangers shall not contact pipe where pipe is specified to be insulated. Insulation shall run continuous through the pipe hanger.

3.02 INSPECTION:

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.03 HVAC PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation; on heating piping beyond control valve, located within heated space; and on unions, flanges and strainers.
- B. Hot Pressure Piping (to 250°F):
 - 1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (steam piping up to 100 psi, water piping up to 200 degrees F).
 - a. HVAC hot water supply and return piping, valves and fittings.
 - 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1" thick for pipe sizes up to and including 1", 1-1/2" thick for pipe sizes 1-1/4" through 4", 2" thick for pipe sizes over 5".

3.04 DUCTWORK SYSTEM INSULATION:

- A. Insulation Not Required: Do not insulate lined ductwork, except as noted, or exposed to weather.
- B. Hot, Cold and Dual Temperature Ductwork:
 - 1. Application Requirements: Insulate the following ductwork:
 - a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.
 - b. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet. Insulate neck and bells of supply diffusers.
 - c. HVAC return ductwork between room terminal inlet and return fan inlet, or HVAC unit inlet: except omit insulation on return ductwork located in return air ceiling plenums.
 - 2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:
 - a. Rigid fiberglass: 1-1/2" thick, increase thickness to 2" in machine, fan and equipment rooms.
 - b. Flexible Fiberglass: 1-1/2" thick, application limited to concealed locations.
- C. High and Medium Velocity Duct: Insulate externally with 1-1/2" thick fiberglass faced duct wrap Type IV with factory applied flame retardant foil reinforced Kraft facing FRK-25 U.L. label.
- D. Duct Insulations:
 - 1. Wrap insulation snugly on the ductwork such that maximum thickness is maintained. Butt all circumferential joints and overlap longitudinal joints a minimum of 2". Adhere insulation with 4" strips of Insulation Bonding Adhesive, at 8" on center.

2. On circumferential joints, staple the 2" flange of the facing with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforcing Kraft tape. Tape all pin penetrations or punctures in the facing.

3.05 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on all pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
- I. Saddles and Shields:
 1. General: Except as otherwise indicated, provide protection saddles or thermal hanger shields with protection shields under all piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and thermal shields for exact fit to mate with pipe insulation.
 2. Protection Saddles: See section Supports and Anchors for saddle. Fill interior voids with segments of insulation matching adjoining insulation.
 3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation. Use on pipes 1-1/4" and smaller. Use with thermal hanger shields for pipes 1-1/2" and larger.
 4. Thermal Hanger Shields: High density calcium silicate encased in 360 degrees sheet metal shield. Provide assembly of same thickness as adjoining insulation. Use on pipes 1-1/2" to 8".

3.06 INSTALLATION OF DUCTWORK INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- G. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.
- H. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.07 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during construction period to avoid damage and deterioration.

END OF SECTION 15250

SECTION 15300 - FIRE PROTECTION SYSTEMS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the contract apply to this section.
- B. Technical sections which describe related work such as Division 16 apply to this section.
- C. Other Division 15 specifications apply to this section.

1.02 SUMMARY:

Furnish all materials, equipment and supplies and perform all work and operations to construct and make functional the fire protection systems in accordance with the drawings and these specifications. Reference to other specifications, codes, standards or manuals which are a part of these specifications, but are not included herein, shall be the latest adopted edition of these publications.

1.03 QUALITY ASSURANCE:

- A. Manufacturers: Firm engaged in the manufacture of fire protection equipment of the type and sizes required to complete the project.
- B. Installer: The sub-contractor for each of the fire protection systems shall be duly licensed by the state, county and city in which the project is being constructed. The sub-contractor must be engaged in the installation of automatic fire protection systems and be fully familiar with all local conditions, specified codes and requirements.
- C. Designer: The designer for the fire sprinkler system shall be a staff employee of the "Installer" and shall be a Utah State licensed fire protection engineer or a Certified Engineering Technician in Fire Protection (NICET IV). The Certification shall be active during the entire contract period. The designer shall certify that the drawings and installation are in accordance with the intent of the plans and specifications. The designer shall make a complete and final inspection of the installation, including operating all alarms, control valves checking all piping, seismic bracing, hangers, etc. After checking all components of the system, he shall provide a letter stating that the installation is complete, operational and in accordance with approved plans and specifications. If changes have been made in the installation since the plans were approved, the designer shall correct the shop drawings and provide as-built drawings to the Owner with the letter.

1.04 SUBMITTALS:

- A. Shop Drawings: The fire sprinkler contractor shall prepare complete shop drawings for the modified sprinkler system. Shop drawings shall be coordinated with structure and with all other trades. Show ceiling grid, lights, grilles, ducts, registers and diffusers, smoke detectors, sound speakers, etc. Draw sections to show relative elevations of piping, ductwork, conduit, cable trays, ceiling grid, beams, etc. Show heads symmetrically related to ceiling patterns and show heads centered in tiles in grid. The shop drawings shall contain, as a minimum, the information outlined and listed in NFPA 13 chapter 8. Submit fire sprinkler drawings to each Authority Having Jurisdiction for review prior to starting work. Final design shall incorporate all requirements of the AHJ's. Work only from reviewed documents.
- C. Descriptive Data: Descriptive data shall be submitted on the following items of material and/or equipment. Such data shall consist of manufacturer's or supplier's catalog information in sufficient detail to allow verification that the material and/or equipment meets the specification requirements, or is equal to that specified.

1. All trim, pipe, fittings, couplings and sprinkler heads.
 - D. Submittal Procedure: Submit 2 copies of the fire sprinkler drawings, calculations and equipment data, to the Richfield City Fire Department for review. Submit 7 copies of the fire sprinkler drawings, calculations and equipment data to general contractor. The general contractor shall forward 7 copies to the project architect.
 - E. Upon completion of installation submit to Architect two copies each:
 1. "Contractor's Material & Test Certificate for Aboveground Piping." Furnish a report for, wet-pipe systems.
 2. As-built shop drawings with designer's signature and certification number. As-Built drawings shall be submitted on Mylar.
- 1.05 REFERENCES:
- A. CODES AND STANDARDS:
1. NFPA (National Fire Protection Association) 13, "Installation of Sprinkler Systems".
 2. IFC (International Fire Code), 2003.
 3. IBC (International Building Code), 2003
 4. Underwriters Laboratories "Fire Protection Equipment Directory".
 5. Factory Mutual Systems "Approval Guide".
- 1.06 GUARANTEE:
- A. Furnish a one-year guarantee for all equipment, materials, and installation, including all labor, transportation, and equipment. Make all installation compliant with Utah State Fire Marshall requirements as part of the Guarantee.

PART II - AUTOMATIC FIRE SPRINKLER SYSTEMS:

- 2.01 SCOPE OF WORK:
- A. To include revising of existing fire protection to cover remodeled areas of the building. Design and install revised automatic fire sprinkler system(s) in accordance with NFPA 13 throughout the additional remodeled portions of the buildings, including any combustible ceiling spaces and inside or around any building features which obstruct sprinkler discharge. The system shall be hydraulically designed. In areas where lay-in ceiling occur, heads shall be centered in tiles. The design shall be based upon the following:
1. Classrooms, corridors: Light hazard, 0.10 gpm over most remote 1500 square feet of floor space, including 500 gpm for hose at the point of connection.
 2. The authorities having jurisdiction and whose approval of the systems is required include:
 - a. Richfield City Fire Marshall.
 - b. State of Utah Fire Marshall's Office.
 - c. Owners insurance company.
 - d. P+A Architects/Heath Engineering Company.
 3. Contractor to coordinate with Owner personnel to perform a water flow test to provide water supply psi static, psi residual flowing gpm. Pressure hydrant number, flow hydrant number.

2.02 **PIPING AND EQUIPMENT:**

- A. All equipment shall be U.L. listed and/or FM approved and installed in accordance with its listing and NFPA 13 requirements. Use only domestic piping and equipment - manufactured in USA.
- B. All piping shall be Schedule 40 or heavier meeting the requirements of ASTM A53.
- C. Special pipe such as XL or other light wall pipe shall not be used.
- D. Fittings shall be 175 lb. (cold water)
 - 1. Cast iron, black or galvanized, screwed or flanged, UL approved, ASTM A-126, Class A, ANSI B16.4 or B16.1.
 - 2. Malleable iron, screwed, black or galvanized, Class 150, UL approved, ANSI 16.3.
- E. Unions two inches and smaller shall be 300 lb., black or galvanized as required to match piping, malleable iron, brass to iron seats, UL listed, ASTM A-197.
- F. Flanges shall be 175 lb. (cold water), cast iron, black, flat-faced, screwed pattern, UL listed, ASTM A-126, Class A, ANSI B16.1
- G. Sprinkler Heads: Selection varies depending on occupancy and type of finish, all head styles and finishes based on compatibility with Architectural material, texture and color palette. Head locations are to respect Architectural ceiling patterns. Reference plans for head style.
 - 1. All spaces with finished ceilings: Reliable Model "G" either concealed sprinkler with white cover plate or pendent with white escutcheon. Match existing heads. 1/2" orifice, 165°F rated.
 - 2. Unfinished Ceiling Areas: Reliable Model G, upright or pendant, brass, 1/2" orifice, ordinary temperature rated. Sprinkler heads in Mechanical Equipment Rooms, and Janitor's Closet shall be furnished with guards.
 - 3. Sidewall Installation: Reliable Model G, with 1/2" escutcheon, white, finish for each location. 165°F rating.
 - 4. Provide a minimum of 6 spare heads of each type in a cabinet and one head wrench for each type sprinkler. The minimum number of spare sprinklers provided shall be in accordance with NFPA 13 3-2.9.3 except a minimum of 18 spare sprinklers shall be provided.
 - 5. Approved Manufacturer's:
 - a. Reliable
 - b. Victaulic
 - c. Gem

2.03 **HANGERS:**

- A. Hangers shall conform to the minimum requirements of NFPA 13.

2.04 **SEISMIC FITTINGS AND BRACES:**

- A. Earthquake bracing is required and shall conform to the minimum requirements of NFPA 13.

PART III - INSTALLATION:

3.01 INSTALLATION:

- A. Install complete. Drawings generally indicate appropriate and desired location of heads in primary spaces. Pick up and provide coverage of incidental spaces not specifically treated on drawings.
- B. Offset as needed for other trades. Avoid conflict in areas of tight construction. Run mains in beam and truss space where space between bottom of truss is insufficient for all. Do not obstruct access to air control boxes, access doors, lights or other ceiling mounted equipment. Modify installed work as needed to clear other installation.
- C. Respect the concept of Uniform ceiling patterns and appearance.
- D. Submit piping and equipment data sheets for review by the Architect/Engineer prior to start of the installation.
- E. Cutting of structural members for the passage of sprinkler piping or for pipe hanger fastening is not permitted except with structural engineers concurrence. Selective sleeving through beams may be possible with structural engineers concurrence.
- F. Provide sleeved holes through interior walls, floor, and ceilings large enough to accommodate pipe expansion. Seal around pipe penetrations with "Firesafeing" material.
- G. Provide long runs of pipe with suitable means to permit free movement.
- H. Close pipe openings with caps or plugs during installation. Cover and protect components of the system against dirt and chemical or mechanical injury.
- I. Paint exposed piping for sprinkler system in accordance with requirements of Division 09000.
- J. Install insulation, with facing towards interior, where indicated on the drawings. Follow insulation manufacturer's installation recommendations.
- K. Note requirement for symmetrical head placement and centering in grid.

3.02 TESTING:

- A. Hydrostatically test all system piping for two hours at 200 psi with no loss in pressure and no visible leakage. Conduct the testing after all of the fire sprinkler heads and piping are installed. Have the tests witnessed by the AHJ's and Engineer. Submit a Contractor's Material and Test Certificate to the Architect upon successful completion of the testing.
- B. Train the Owner's maintenance personnel in the proper operation, testing and maintenance of all installed equipment.
- C. Conduct an inspection and operational test (main drain and inspector's test) at the end of the one-year guarantee period. The inspection and testing shall be in accordance with manufacturer's recommendations and NFPA 13A. A written report is to be sent to the Owner upon completion of the inspection. Fire sprinkler installer shall conduct the tests.

3.03 FIELD QUALITY CONTROL:

- A. Obtain permits and post bonds as required by state and local AHJ's (Authorities Having Jurisdiction).
- B. Inform AHJ's of job progress. Request presence of AHJ'S, perform tests, and document results using Contractor's Material and Test Certificates.

3.04 DISINFECTION:

- A. Introduce dosage of 50 ppm chlorine in overhead piping. During the contact period open and close all system valves several times. At end of 24-hour retention period at least 10 ppm shall remain throughout the piping.
- B. At end of retention period, flush system until residual chlorine is reduced to less than 1.0 ppm.

3.05 CLEANING:

- A. Remove oil, scale, debris, and foreign substances from interior and exterior of devices, equipment, and materials prior to installation.
- B. Upon job completion, remove tools, surplus materials and equipment, leaving all areas broom clean.

3.06 ACCEPTANCE:

- A. Acceptance of installation is subject to final inspection and approval by:
 - 1. Richfield Building and Fire Department
 - 2. Utah State Fire Marshal's Office
 - 3. Architect or his representative.

END OF SECTION 15300

SECTION 15515 - HYDRONIC PIPING AND SPECIALTIES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. All pertinent sections of Division - 15 General Mechanical Requirements are a part of the work described in this section.
- B. All pertinent sections of Division - 15 General Pipes and Fittings are a part of the work described in this section.
- C. Other Specification sections related to Insulation, System Commissioning, Testing and Balancing.

1.02 SUMMARY: Work shown on the drawings and required by these specifications including incidental work classified as "best practices of the trade".

- A. Heating water systems.
- B. Other work as indicated.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of hydronic piping products and equipment of types, materials and sizes required, whose products have been in service for not less than 5 years.
- B. Installer's Qualifications:
 - 1. Firm with at least 3 years history of successful experience on projects of similar nature.
 - 2. Licensed as a firm in the Contractor state of origin and in the State of Utah.
 - 3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.
 - 4. All workmen employed on the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical literature indicating source, brand, type, model, performance characteristics, installation instructions, etc.
- B. Record Drawings: See Division - 15.
- C. Operation And Maintenance Information: Provide information for all equipment including a comprehensive system operating description. See Section 15195.
- D. Instruction Of Owner's Personnel: Participate in specified instruction. See Division - 15.
 - 1. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion).

2. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.05 REFERENCES:

A. Standards: Comply with applicable sections, follow recommended practices.

1. State Boiler and Pressure Vessel Regulations
2. ASME Codes for Boilers and Pressure Vessels
3. State and Local Plumbing and Mechanical Codes
4. International Building Code/International Mechanical Code
5. ASHRAE Handbooks

PART II - MATERIALS AND METHODS - HEATING WATER, AND CHILLED WATER

2.01 PIPING AND FITTINGS:

- A. Schedule 40 black steel, A-53 with malleable steel threaded fittings up to 2" size and forged steel welding fittings 2-1/2" and larger. Contractor option to use a grooved joint system accommodating for additional support and insulation work. Do not use grooved piping from Cooling Tower to entering mechanical room condensing pump.
1. Rigid type AK@or AL@copper, bronze or dielectric interface.
- B. Drains And Overflow: Install piping of any size from drains and overflows using standard weight galvanized steel piping with standard weight galvanized malleable fittings free from fins and burrs, with standard pipe threads. Drains and over flows shall be terminated over floor drains or drain funnels adjacent to equipment. Furnish drains from all pump bases to floor drains.
- C. Water Connections: Provide piping and fittings connecting to the domestic water system, such as fill lines, makeup water lines, etc., of Type K or L copper tubing with solder joint type wrought copper or wrought bronze fittings. Copper piping shall be connected to equipment and steel piping with insulated unions to prevent electrolysis.

2.02 GENERAL SERVICE VALVES: Comply with Section "Valves".

- A. General: Provide valves complying with Division-15 General Mechanical Materials and Methods section "Valves", in accordance with the following listing.
1. Sectional Valves:
 - a. 3" and Smaller: Ball valves.
 - b. 4" and Larger: Butterfly valves.
 2. Shutoff Valves:
 - a. 3" and Smaller: Ball valves.
 - b. 4" and Larger: Butterfly valves.

- 3. Drain Valves:
 - a. 3" and Smaller: Ball valves.
- 4. Check Valves:
 - a. All Sizes: Swing check valves where space permits, else use wafer type.
 - b. Pump Discharge: Non-slam, pump discharge check.

2.03 MISCELLANEOUS VALVES AND SPECIALTIES: See Section "Valves".

2.04 CIRCUIT BALANCE VALVES:

- A. Circuit balance valve for flow balance complying with Section AValves@.

2.05 VENT VALVES:

- A. Manual Vent Valves: Provide manual vent valves designed to be operated manually. Use ball valve.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vent valves which may be incorporated in the work include, but are not limited to, the following:
 - 1. Armstrong Machine Works.
 - 2. Bell & Gossett ITT; Fluid Handling Div.
 - 3. Hoffman Specialty ITT; Fluid Handling Div.
 - 4. Spirax Sarco.
 - 5. Amtrol.

2.06 STRAINERS:

- A. General: Y pattern, self cleaning, line size.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide strainers of one of the following:
 - 1. Armstrong
 - 2. Watts
 - 3. Victaulic
 - 4. Mueller
 - 5. Spirex Sarco
 - 6. Metraflex
- C. 2" and Smaller: Watts No. 77S or equal in Armstrong, 250 lb. iron body, threaded, Y-pattern, 20-mesh stainless steel screen, full size drain connection with ball valve.
- D. 2-1/2" and Larger: Watts No. 77F-125 or equal in Armstrong, 125 lb. iron body, flanged, Y-pattern, stainless steel screen, drain connection with ball valve.

PART III - EXECUTION

3.01 INSPECTION:

- A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed.

3.02 GENERAL SYSTEM INSTALLATION:

- A. Arrange system in a neat, orderly and functional manner. Maintain access around all equipment. Provide sheeves for all structural penetrations.
- B. Plan ahead for seismic restraint and vibration isolation.
- C. Verify adequate ventilation for heat producing equipment, watch out for possible freezing conditions.
- D. Air Vents and Line Drains: Provide air vents at all high points of piping systems with vent line extended to valve installed in accessible location 5'-0" above the floor, vent line extended to drain. Provide drain valves at all equipment and at low points in the system, extend drain lines to drain funnel or floor sink.
- E. Provide pressure gauges and thermometers and pressure/temperature plugs as indicated on the flow diagrams, piping plans and equipment details.

3.03 INSTALLATION OF HYDRONIC PIPING:

- A. General: Install hydronic piping in accordance with Division-15 "General Pipes and Fittings."
- B. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
- C. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

3.04 INSTALLATION OF PIPING SPECIALTIES:

- A. Install piping specialties in accordance with Division-15 "Hydronic Piping and Specialties."

3.05 INSTALLATION OF SUPPORTS AND ANCHORS:

- A. Install supports and anchors in accordance with Division-15 "Mechanical Supporting Devices."

3.06 INSTALLATION OF VALVES:

- A. Install valves in accordance with Division-15 "Valves."
- B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.
- C. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.

- D. Hydronic Terminal Outlet Valves: Install on inlet of each hydronic terminal, and elsewhere as indicated.
- E. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.
- F. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

3.07 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS:

- A. General: Provide for expansion and contraction of all piping systems with anchors, guides, loops, expansion joints, grooved joints, etc. Provide one expansion loop for every 100 feet of pipe or fraction thereof.

3.08 EQUIPMENT CONNECTIONS:

- A. General: Connect hydronic piping systems to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection.
- B. Hydronic Terminals: Install hydronic terminals with hydronic terminal shut-off valve and union on outlet; union, shutoff valve on inlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing valves behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions on supply line.

3.09 INSTALLATION OF HYDRONIC SPECIALTIES:

- A. Balance Valves: At locations shown on drawings.
- B. Vent Valves:
 - 1. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated.

3.10 TESTS:

- A. Isolate sections of piping and equipment and pressure test to 175 psi or 1-1/2 times the maximum potential pressure of the system, but not to exceed the test pressure rating of a system component.

Conduct an air pressure test, using a soap solution to check for leaks. Establish the pressure, close off the pressure source and let stand for 24 hours. Given constant temperature, there should be no drop in pressure.

After the air test, fill the system with water, raise to test pressure and inspect for leaks. Repair all leaks. Repeat tests. Report and certify all tests.

- B. Test other system components as needed to verify proper assembly and installation.
- C. Participate in overall system test and balance work.

END OF SECTION 15515

SECTION 15545 - CHEMICAL WATER TREATMENT

PART I - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Types of chemical treatment specified in this section include the following:
 - 1. Heating Water System
 - 2. Final Treatment.

PART II - PRODUCTS

PART III - EXECUTION

3.01 HEATING WATER AND CHILLED WATER SYSTEM CLEANING AND TREATMENT:

- A. Provide valved bypass lines as needed to allow recirculation. Provide valve connections needed to fill, vent and drain system.

Use a treatment schedule similar to the following, but to be verified compatible with system materials.

- 1. Fill, circulate, drain system, clean strainers. Use clean water.
- 2. Fill, introduce sodium triphosphate or suitable degreaser, take the water to operating temperature, circulate for minimum of 5 hours, drain, flush.
- 3. Fill system with water, ready for final treatment.
- 4. Fill, introduce oxygen scavenger/inhibitor such as sodium borate-nitrite with phenolphthalein, circulate.
- 5. Maintain inhibitor/scavenger and glycol concentrations for entire first year, replace if lost.
- 6. For one year, water treatment company to supply chemicals, including glycol, and appropriate on-site service.

3.02 DOMESTIC WATER SYSTEM: Refer to Division - 15 #Water Distribution Piping and Equipment@for cleaning and disinfection.

- A. Use Sodium Hypochlorite solutions.

END OF SECTION 15545

SECTION 15830 - TERMINAL HEAT TRANSFER UNITS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Motors Drives and Electrical Requirements for Mechanical Systems, General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

1.02 SUMMARY:

- A. Types of terminal units required for project include the following:
 - 1. Cabinet heaters, heating water.

PART II - PRODUCTS

2.01 CABINET HEATERS:

- A. General: Provide cabinet heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, filter rails, motor, electric junction box and insulation.
- B. Chassis: Galvanized steel wrap-around structural frame with edges flanged.
- C. Insulation: Faced, heavy density glass fiber.
- D. Cabinet: 16-ga removable bottom panel. Insulate front panel over entire coil section. Provide access door on coil connection side and for motor control. Tamper proof screws fastener on bottom panel with safety chain. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer.
- E. Water Coils: Construct of 5/8" seamless copper tubes mechanically bonded to configured aluminum fins. Design for 200 psi and leak test at 300 psi under water. Provide same end connections for supply and return. Each element shall have manual air vent.
- F. Fans: Provide centrifugal, forward curved double width fan wheels. Construct fan scrolls of galvanized steel.
- G. Motors: Provide shaded pole motors with integral thermal over-load protection, and motor cords for plug-in to junction box in unit. Motors shall be permanently lubricated.
- H. Motor Speed Control: Solid state, multi-speed with "off" position, unit mounted.
- I. Filters: Provide 1" thick throwaway type filters in fiberboard frames.
- J. Controls: Furnish unit with factory mounted fan speed switch and aquastat. Set up for field mounting of control valve, isolation valves, balance valve, and DDC control. On a call for heat, thermostat will make, control valve will open. Once circulating hot water is sensed by aquastat, fan will run on one of its manually selected speeds. See detail on drawings.

- K. Unit color to be as selected by Architect. Furnish paint samples for selection.
- L. Manufacturer: Subject to compliance with requirements, provide cabinet heaters of one of the following:
 - 1. Airtherm Mfg. Co.
 - 2. Dunham-Bush, Inc.
 - 3. McQuay Inc.
 - 4. Trane (The) Co.
 - 5. Young Radiator Co.
 - 6. Modine
 - 7. Stering

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF UNIT HEATERS:

- A. General: Install heaters as indicated, and in accordance with manufacturer-s installation instructions.
- B. Locate heater as indicated.
- C. Install piping as indicated.
- D. Provide and install hangers and supports for heaters. Support heater independently from the structure above.

3.03 ELECTRICAL WIRING:

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Coordinate with the ceiling system.

3.04 ADJUSTING AND CLEANING:

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION 15830

SECTION 15890 - DUCTWORK

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork required for the project include the following:
 - 1. Round
 - 2. Rectangular
 - 3. Oval
 - 4. Spiral
 - 5. Factory Duct
- C. Exterior Insulation of metal ductwork is specified in other Division-15 sections, and is included as work of this section.
- D. Refer to other Division-15 sections for exterior insulation of metal ductwork; not work of this section.
- E. Refer to other Division-15 sections for ductwork accessories; not work of this section.
- F. Refer to other Division-15 sections for mechanical controls; not work of this section.
- G. Refer to other Division-15 sections for air control boxes; not work of this section.
- H. Refer to other Division-15 sections for grilles and diffusers; not work of this section.
- I. Refer to other Division-15 sections for system commissioning, testing and balancing; not work of this section.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
- B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.
- C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 1.
- D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

1.05 REFERENCES:

- A. Codes and Standards:
 - 1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
 - 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".
 - 4. Uniform Building Code/Uniform Mechanical Code: Comply with all sections pertaining to mechanical work.
- B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.01 DUCTWORK - GENERAL:

- A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, 1988 edition, Chapter 1, Duct Construction

- B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.
- C. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, seams shall show continuity.
- D. Stainless Steel Assemblies: Fabricate of Type 304 SS or Type 316 SS stainless steel sheet complying with ASTM A-167 with all welded joints and seams. Provide polished No. 4 satin finish for all hoods and duct exposed to view, No. 1 finish elsewhere. Protect finished surfaces with mill applied adhesive protective paper through fabrication and installation.

2.02 FITTINGS AND FABRICATION:

- A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° lateral and 45° elbows for branch take-off connections. Where 90° branches are indicated, provide conical type tees.
- B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Duct Accessories" for accessory requirements.
- D. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
- E. Offset, transition, adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the owner.

2.03 DUCT PRESSURE CLASSIFICATIONS:

- A. For all VAV systems:
 - 1. From fan discharge to VAV terminal box inlet: medium pressure ductwork, 10" w.g.
 - 2. Rectangular supply air ductwork downstream of VAV terminal box: Low pressure rectangular ductwork, 3" w.g. Low pressure round ductwork exposed to view spiral lackseam, 3" w.g.
 - 3. Branch round supply air ductwork runout from rectangular ductwork to diffuser: Low pressure round ductwork, 1" w.g.

4. Outside air ductwork and plenums, 10" w.g.
5. Relief air plenums, 3" w.g.

2.04 LOW PRESSURE ROUND DUCTWORK: (1" SMACNA Pressure Class)

- A. Round type ductwork for use on low velocity supply systems (1200 fpm maximum), low pressure (0.75" maximum duct pressure), shall be fabricated on 26 gauge galvanized steel sheets with snap-lock longitudinal seams and crimped and beaded joints.
- B. All end joints shall have at least three screw fasteners and shall be wrapped airtight. Transverse and longitudinal seams shall be taped with "Hardcast TA". Elbows and fittings shall provide smooth air flow patterns and have a neat appearance.
- C. Use factory fabricated elbows of the multi-sectional adjustable type.

2.05 LOW PRESSURE RECTANGULAR DUCTWORK: (3" SMACNA Pressure Class)

- A. Rectangular ductwork for use on supply systems up to 2" maximum duct static pressure and 2000 fpm maximum duct velocity shall be constructed of galvanized steel using construction for nominal 3" SMACNA rated systems. Seal all transverse joints with duct cement or tape with "Hardcast TA".
- B. Use radius elbows or turning vanes with extended trailing edge. Use 45° tapping takeoffs with downstream balance damper.
- C. Duct dimensions are inside clear. Increase for acoustical lining.
- D. For rectangular exhaust ducts, increase metal gauge by 2 (i.e. 20 to 18) for all sizes. Seal all joints.

2.06 MEDIUM PRESSURE DUCTWORK: (10" SMACNA Pressure Class)

- A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
- B. Round Ductwork: Construct of galvanized sheet steel complying with ASTM A 527 by the following methods and in minimum gauges listed.

<u>Diameter</u>	<u>Minimum Gauge</u>	<u>Method of Manufacture</u>
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
Over 60"	16	Longitudinal Seam
60" to 84"	18	Spiral Lockseam

Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

- C. Round Duct Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams. Mitered elbows shall be of at least 5 piece construction with R/D ratio of 1.5.

<u>Diameter</u>	<u>Minimum Gauge</u>
3" to 36"	20
38" to 50"	18
Over 50"	16

- D. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ASTM A 527, of spiral lockseam or longitudinal seam construction, in minimum gauges listed.

<u>Minimum Maximum Width</u>	<u>Gauge Spiral</u>	<u>Longitudinal</u>
Under 25"	24	22
25" to 48"	22	20
49" to 70"	20	18
Stiffener Inserts 4'-0" on Center		

- E. Flat-Oval Duct Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

<u>Maximum Width</u>	<u>Minimum Gauge</u>
Under 37"	20
37" to 50"	18
Over 50"	16

- F. Internally Insulated Duct and Fittings: Construct with outer pressure shell, 1" or 2" thick (as indicated on drawings) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, use longitudinal seam for over 59", in minimum gauges listed. Use where indicated on drawings.

Equivalent to United McGill "Acoustic-K27".

<u>Nominal Duct Diameter</u>	<u>Outer Shell</u>	<u>Inner Liner</u>
3" to 12"	26 gauge	24 gauge
13" to 24"	24 gauge	24 gauge
25" to 34"	22 gauge	24 gauge
35" to 48"	20 gauge	24 gauge
49" to 58"	18 gauge	24 gauge
Over 59"	16 gauge	20 gauge

- G. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell. Construct fittings to close tolerance with ductwork.

<u>Nominal Duct Diameter</u>	<u>Outer Shell</u>	<u>Inner Liner</u>
3" to 34"	20 gauge	20 gauge
36" to 48"	18 gauge	20 gauge
Over 48"	16 gauge	20 gauge

- H. Field joints shall be made up using an initial coat of 3M EC-750 adhesive wrapping the joint with a 3" wide fiberglass strip and applying a final seal coat of adhesive to the fiberglass. Duct sections and fittings shall be held in place at joints with sheet metal screws 6" on centers. Simple coating of joint surfaces with mastic prior to joining is not acceptable (SMACNA Std. P.1-11).
 - 1. As an alternative method of duct joint sealing, the joints shall be held in place with screws as specified, but the contractor may use "Thermofit" duct sealing bands as manufactured by Rayclad Tubes of Menlo Park, California. Bands shall be installed according to the manufacturer's directions. The open flame shall not be used in the vicinity of combustible materials.
- I. Oval ductwork shall be installed where called for on the plans and where required to conform to tight space requirements encountered during construction. The contractor shall furnish transition pieces as required. Oval ductwork shall have equivalent capacity to the round duct.
 - 1. At the Contractor's option odd inch diameter round ducts may be increased in size to the next larger even inch providing space considerations are accommodated and all related conditions are resolved by the contractor.

2.07 FACTORY DUCT:

- A. Extent of Work: Provide factory duct at connections to air terminal units, at runouts to grilles and diffusers, at points of round to round flexible connections (see also "Flexible Connections") and at other locations indicated or required.
- B. Prohibited Material: Do not use single wire helix ducting with vinyl or plastic liner of any type.
- C. Factory Duct Non-corrosive Environments: Woven fiberglass fabric impregnated with vinyl or neoprene clamped in a continual helix of aluminum or cold rolled steel. U.L. listed for Class 1 duct, compliant with NFPA 90A and 90B, pressure rated to 12" w.g., equivalent to:
 - 1. Non-insulated: Wiremold 57; Flexmaster Type N145
 - 2. Insulated: Flexmaster Type 4; Thermaflex M-KC
- D. Installation: Follow manufacturers instructions. Use stainless steel or nylon band clamping rings. In general, do not use lengths in excess of 3 feet. Make bends only in long radius format. Support duct to avoid droops and kinks.

2.08 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Runout Fittings: Runout fittings shall be used to make round to rectangular duct connections. Use 45° time and a half square to round fittings. Provide with locking quadrant dampers where balance is involved. Provide with insulation guard where insulated duct is involved.

- C. Duct Sealing Compound: Duct sealing compound shall be 3M brand number EC-750 or Duro-Dyne S-2. This material shall be used in making up duct joints or in water proofing, caulking plenums, etc.
- D. Acoustical Lining: Acoustical lining in ducts shall be 1" thick, 1-1/2 pound density, coated, flexible glass fiber type, set in adhesive and impaled on weld studs spaced not more than 12" on centers and secured with lock washers. Airstream surface faced with black coated matte. Acoustical lining shall completely line the ducts. Lining shall have a fire and smoke hazard rating not exceeding 20-50-50. Owens-Corning, Johns-Manville, Certainteed.
 - 1. All joints, edges and/or surface breaks in the coating of the acoustical lining shall be pointed up to a smooth surface with adhesive.
- E. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives and Duct Thermal Insulation".
- F. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.
- G. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
- H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- I. PLENUMS :
- J. General: Provide built up factory system as indicated, of sizes and capacities as scheduled, and as specified herein.
 - 1. Each system shall be field assembled, except for those items requiring field installation such as temperature control components.
 - 2. Each system shall be mounted on a concrete base. Each system shall be prime coated inside and out prior to any insulating and finished with a baked-on enamel finish.
 - 3. Provide access doors to service all internal components. Where unit sizes are large enough, access doors shall be of a size capable of allowing a man to pass through. Each door shall have a minimum of 2 heavy-duty hinges and 2 quick-opening knurled knob latches. Each door to have 6" x 6" wire glass window.
 - 4. Doors shall be operable without the aid of any tools. Each door shall seal air tight with a continuous sponge rubber gasket.
 - 5. The final responsibility for a complete and operable system lies with the mechanical contractor. This contractor shall coordinate the efforts of the equipment supplier and subcontractors to insure that final systems are complete.

PART III - EXECUTION

3.01 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK:

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

- B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- D. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.
- E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
1. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of Section "Firestopping".

- F. Ducts At Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.
- G. Cross Breaking: Rectangular sheet metal ducts shall be cross broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid.
- H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

3.03 INSTALLATION OF DUCT LINER:

- A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.04 As indicated on the drawings, supply, return and exhaust air ductwork shall be lined with acoustical insulation.

In all cases outside air ductwork shall be lined with 2' thick 1-1/2 lb. density acoustical lining unless indicated differently on drawings, ie. requiring Type 2 plenum.

3.05 INSTALLATION OF FLEXIBLE DUCTS:

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 3'-0" extended length. No elbows allowed.
- B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".

3.06 HANGERS AND SUPPORTS:

- A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

- B. Construct hangers for rectangular ductwork from galvanized iron 1" x 1/16". Hangers shall extend down the sides of rectangular ducts the full depth of the duct and shall be bent underneath the duct 2". Hangers shall be secured to the duct using sheet metal screws or rivets of appropriate sizes on 6" centers, but not less than two screws in the side and one in the bottom of each hanger.
 - C. For rectangular ducts 36" and greater in width construct hangers from galvanized iron 1-1/2" x 1/16". Hangers shall be installed and secured to duct as described in Paragraph B.
- 3.07 SUPPORTING DAMPERS: Parallel and opposed blade motor operated dampers shall be supported by reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine.
- 3.08 CONNECTIONS: Connections of high velocity supply and exhaust ducts, fittings, and high velocity mixing boxes shall be made airtight by coating joints with Minnesota Mining Co. Mastic, Type EC-800, Benjamin Foster, Sheet Metal Products Co., or approved equal, before joining, and then sealing the joint with one layer of "Glass-Fab" reinforcing tape set in a coating of the above compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.
- 3.09 AESTHETIC LAYOUTS: Contractor shall locate all diffusers, grilles and other exposed items in such a manner as to fit symmetrically in any grid system or other aesthetic architectural or lighting pattern. Refer to reflected ceiling plans and electrical lighting layouts for additional information. Provide duct offsets or extensions as required to make a proper installation.
- Close or cap all duct ends. Use auxiliary blower with air flow meter to establish a duct pressure equivalent to the duct pressure class. Inspect all joints in duct system and seal all identifiable leaks.
- 3.10 FIELD QUALITY CONTROL:
- A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.
- 3.11 ADJUSTING AND CLEANING:
- A. Clean ductwork internally of dust and debris, as follows: Before the ceilings are installed, with filters in place, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.
 - B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Balancing:

1. Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.
2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION 15890

SECTION 15910 - DUCTWORK ACCESSORIES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork accessories required for project include the following:
 - 1. Dampers.
 - a. Low pressure manual dampers.
 - b. Control dampers.
 - 2. Fire and smoke dampers.
 - 3. Turning vanes.
 - 4. Duct hardware.
 - 5. Duct access doors.
- C. Refer to other Division-15 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.05 REFERENCES:

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.01 DAMPERS:

- A. Control dampers are furnished by the Mechanical Control Section but installed by this Section. Dampers shall be supported, plenum openings shall be reinforced, the entire assembly shall be sturdy and operate smoothly. Install dampers to direct outside and return air into each other for mixing.
- B. Control dampers for balance only where tight shutoff is not critical are to be furnished and installed by this Section.
1. Honeywell D-643.
 2. Johnson D-2300.
 3. Ruskin MD-35

2.02 FIRE DAMPERS:

- A. Fire dampers shall be by Ruskin, United, Louvers and Dampers, Arrow, Airolite, Phillips, Tuttle and Bailey.
- B. Whenever a duct penetrates a fire separation, install a fire damper to restore the integrity of the fire partition. The requirement of this Section is to install fire dampers at fire wall penetrations, in openings in rated ceilings, at entrance to and exit from a vertical chase in all ducts with the possible exception of certain conditions exempted by the authority having jurisdiction.

- C. Fire dampers shall be of the folding blade type with the blades completely out of the air stream, with fusible link, angle iron frame and counter-weights or spring loaded to provide positive closure. Fire dampers shall be U.L. listed 555 and conform to NFPA 90A. Dampers shall mount in steel sleeves with angle iron frames of NFPA approved design. Links shall be 165° for cold and return air, 212° for hot air.
- D. Provide a complete U.L. rated diffuser-fire damper-enclosure assembly for all ceiling diffusers and return air grilles in fire rated ceilings.
- E. **Multi-Blade Fire Dampers:** Galvanized hat-shaped steel channel frame, steel 14 gauge airfoil shaped double skin construction blades, silicone rubber blade edge seals, flexible compression jamb seals. Stainless steel bearings, fusible link UL 555S, leakage Class II. Ruskin FD60.
- F. Provide access doors in duct and ceiling or partition as required to service dampers. Label access doors with a white sticker with red lettering.

2.03 SMOKE DAMPERS:

- A. Galvanized hat-shaped steel channel frame, 14-gauge steel airfoil shaped double skin construction blades, silicone rubber blade edge seals, flexible compression jamb seals. Stainless steel bearings, fusible link UL 555S, leakage Class II. Damper and operator are to be qualified for elevated temperature categories. Ruskin FSD60. Damper and operator to be normally closed. Pneumatic actuator.

2.04 COMBINATION FIRE/SMOKE DAMPERS:

- A. Galvanized hat-shaped steel channel frame, steel airfoil shaped double skin construction blades, silicone rubber blade edge seals, flexible compression jamb seals. Stainless steel bearings, fusible link UL 555S, leakage Class I. Furnish with factory installed damper operator (pneumatic or electric) to match the existing smoke control system. Damper and operator are to be qualified for 350°F category. Ruskin FSD 60 Class I. Damper and operator to be normally closed. Label (UL) all dampers. Use pneumatic or electric actuator to match existing combination fire/smoke damper installed on this project.
- B. Electric actuator when used shall be 120 volt.
- C. Links shall be 165°F for cold and return air, 212°F for hot air.

2.05 TURNING VANES: Turning vanes shall be installed in all square elbows. Turning vanes shall be single blade. Turning vane spacing shall be per SMACNA.

2.06 DUCT HARDWARE:

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
 - 1. **Test Holes:** Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork. (Bare duct - Ventlok 620, 635; Insulated duct - Ventlok 627, 628, 637, 638, 629.)
 - B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
 1. Ventfabrics, Inc.
 2. Young Regulator Co.
- 2.07 DUCT ACCESS DOORS: Doors shall be 2" narrower than the duct width by 18" up to a maximum of 24" x 18". Duct access doors shall be furnished for all fire damper links, manual controllers and adjustable balancing devices. Duct access doors for all ductwork (except low pressure ductwork) shall be: Bolted access door, oval shaped constructed of an outer door connected to an inner plate by spring loaded carriage bolts with wing handles. Inner plate to have cellular sponge gasket for leak free operation up to 20"wg. The door shall have permanently bonded polyester insulation.

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install hand operated volume and splitter dampers at locations and of sizes shown. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Where volume dampers are installed in ducts over 12" deep, the dampers shall be at least 1-1/2 times as long as the narrowest adjacent split, except where otherwise detailed. Splitter adjustment, accessible at face of finishing ceiling, or equal units by Young Regulator. Splitter dampers and butterfly dampers may be constructed by the Sheet Metal Contractor. All multi-blade hand dampers shall be the product of one of the manufacturers listed in the Contract Documents. All operator fittings shall be heavy duty commercial grade.
- C. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.
- D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL:

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
 - 1. Label access doors in accordance with Division-15 section "Mechanical Identification".
 - 2. Final positioning of manual dampers is specified in Division- 15 section "Testing, Adjusting, and Balancing".
 - 3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 EXTRA STOCK:

- A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 15910

SECTION 15930 - AIR TERMINAL UNITS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of air terminals work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of air terminals specified in this section include the following:
 - 1. Air Control Valves
 - a. VAV Cooling with HW Reheat Heating.
- C. Refer to other Division-15 sections for external insulation of air terminals; not work of this section.
- D. Refer to other Division-15 sections for testing, adjusting and balancing of air terminals; not work of this section.
- E. Refer to other Division-15 sections for temperature controls which are to be furnished by others but installed as work of this section.
- F. Refer to other Division-15 sections for temperature controls for air terminals; not work of this section.
- G. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.03 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer's Qualifications:** A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the contractor.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
- D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 15995.

1.05 REFERENCES:

- A. Codes and Standards:
 - 1. ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.
 - 2. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems".
 - 3. Uniform Building Code/Uniform Mechanical Code: Comply with all sections pertaining to mechanical work.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.
- B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.01 GENERAL:

- A. Under the Base Bid which requests a Direct Digital Control System, a VAV box controller is required which can provide a non-pneumatic, pressure independent, controls sequence.

Fit boxes with volume and temperature sensory and control, see Section 15900.

Box capacity shall be equivalent to that scheduled.

2.02 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide air terminals of one of the following:
1. Titus
 2. Krueger
 3. Price

2.03 SINGLE DUCT VARIABLE VOLUME COOLING WITH HW HEATING (VAVR):

- A. General: Provide factory-fabricated and tested air terminal as indicated, selected with performance characteristics which match or exceed those indicated on the schedule. Vendor/Contractor to verify count and arrangement.
- B. Construction: Factory fabricate VAV damper and heating coil into a single cabinet. Cabinet shall be of 22 gauge or heavier galvanized steel with a 1" thick acoustical lining. VAV damper shall be of air-tight, quarter turn design with shaft supported in sintered bronze or nylon bearings. Design with extension plenum, with access door ahead of coil for coil inspection and cleaning.
- C. Controls: Furnish unit with a package control setup to accomplish the following: See Section 15955. ATC contractor shall furnish box controllers and accessories and make complete installation.
1. Pressure independent digital electronic controller.
 2. VAV damper control, normally closed, (NC).
- D. Heating Coils: Capacity and size as scheduled. Coils minimum 1 row, 10 FPI, with 2 row, 8 FPI provided where capacity dictates.
1. Fins: Corrugated plate sheet aluminum, 0.01" sheet thickness minimum.
 2. Tubes: Copper tube, 5/8" diameter, 0.035" tube, 0.049" bend wall thickness, expand tube into fins.
 3. Headers: Seamless Type K or L copper tube headers and return bends, brazed connections.
 4. Casings: Construct of 16 gauge continuous coated galvanized steel with fins recessed into channels to minimize air bypass.
 5. Testing: Air tested under water to 175 psig.
 6. The successful supplier shall include as part of the submittal, computer generated capacity data for each coil. Certify coil capacities, pressure drops, and selection procedures in accordance with ARI 410.
- E. Acceptable Manufacturers:
1. Titus
 2. Krueger
 3. Price

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF AIR TERMINALS:

- A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer. Protect electrical clearances. Protect access to controls.
- C. Duct Connections: Connect ductwork to air terminals in accordance with Division-15 ductwork sections.
- D. Seismic Restraint: Provide 3-dimensional restraint for all suspended boxes.

3.03 FIELD QUALITY CONTROL:

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.
- B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.04 CLEANING:

- A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 15930

SECTION 15940 - AIR OUTLETS AND INLETS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers and grilles.
 - 2. Wall registers and grilles.
 - 3. Louvers.
 - 4. Exhaust roof caps.
- C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.
- D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.
- E. Refer to other Division sections for louvers, not work of this section.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Samples: 3 samples of each type of finish furnished.
- C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.05 REFERENCES:

- A. Codes and Standards:
 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.01 GRILLES AND DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Adjust all grilles and diffusers to fit neatly in the room ceiling pattern. Set final locations per architectural reflected ceiling plans.
- E. Volume Control Dampers: Provide duct mounted dampers of the externally adjustable opposed blade type where more than one grille or register is on a common duct. Provide access to each damper adjustment.
- F. Sound Level: The diffuser or grille generated noise shall not exceed the following sound power level curve at a point five feet away from the diffuser or grille.

Meeting Rooms: NC25-30
Classrooms: NC 25-30

- G. Fire Dampers: Install fire dampers or smoke/fire dampers at the diffusers, registers and grilles as indicated on drawings or required by code.
- H. Manufacturers: Subject to compliance with requirements, provide grilles and diffusers of one of the following:
 - 1. Hart & Cooley
 - 2. Krueger
 - 3. J and J
 - 4. Carnes
 - 5. Titus
 - 6. EH Price
 - 7. Tuttle & Bailey
 - 8. Anemostat/Waterloo
 - 9. Agitair
 - 10. Environmental Air Products
 - 11. Nailor
- I. Types: Provide grilles and diffusers of type, capacity, and with accessories and finishes as listed on grille and diffuser schedule and as specified herein.
- J. Grilles and Diffusers:
 - 1. Ceiling Supply Diffuser (S-1): Krueger Series 1400A with adjustable tabs for directional air flow control, square face, round neck, four-way deflection, anti-smudge design, removable inner core, all steel construction, appropriate mounting frame, white baked enamel finish, sponge rubber gasket, size as indicated on drawings.
 - 2. Sidewall Supply Register (S-2): Krueger Series 880HOB steel, adjustable, double deflection blades, 3/4" maximum blade spacing, integral volume damper in addition to duct damper, appropriate mounting frame, sponge rubber gasket, baked enamel finish, color selected by Architect, size indicated on drawings.
 - 3. Perforated Return Register (R-1): Krueger Series 6290. Concealed hinge frame, opposed blade volume control damper, sponge rubber gasket, white baked-on enamel, color as selected by architect, size as indicated on drawing.

4. Sidewall Return Register (R-2): Krueger Series S80H. Steel construction, appropriate mounted frame, sponge rubber indicated on drawings. Color selected by Architects.

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

END OF SECTION 15940

SECTION 15955 - MECHANICAL CONTROL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.
 - 1. See following sections for types of Control Systems included as a part of this section:

Section 15960 - Pneumatic Control Systems
Section 15965 - Electric Control Systems
Section 15970 - Direct Digital Control Systems (DDC)
 - 2. Control sequences are specified in this section under: "Sequence of Operation".
- B. Refer to other Division-15 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems.
- C. Refer to Division-16 sections for the following work.
 - 1. Power supply wiring from power source to power connection on controls and/or unit control panels. Includes starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 - 2. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.
- D. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:
 - 1. Control wiring between field-installed equipment, controls, indicating devices, and unit control panels.
 - 2. 120 volt service required by control systems.
- E. Participate in "System Commissioning, Testing and Balancing".

1.03 QUALITY ASSURANCE:

- A. **MANUFACTURER'S QUALIFICATIONS:** Firms regularly engaged in manufacture of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. This project shall be bid using Johnson Controls AMetasys® with alternate pricing by Barber-Coleman ANetwork 8000", Staefa AIntegral II®
- B. **INSTALLER'S QUALIFICATIONS:** Firms and workmen specializing and experienced in electric control system installations for not less than 5 years. Selected from Johnson Controls, Barber-Colman, or Staefa. Installer shall be under the direction of the controls manufacturer.

1.04 SUBMITTALS:

- A. **PRODUCT DATA:** Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
- B. **SHOP DRAWINGS:** Submit shop drawings for each control system, containing the following information:
 - 1. Schematic flow diagram of system showing fans, chillers, boilers, pumps, coils, dampers, valves, and control devices, etc.
 - 2. Label each control device with setting or adjustable range of control.
 - 3. Indicate all required pneumatic tubing and/or electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the existing building.
 - 4. Provide details of faces of control panels, including controls, instruments, and labeling.
 - 5. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.
- C. **SAMPLES:** Submit sample of each type of proposed thermostat cover.
- D. **MAINTENANCE DATA:** Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 15995.

1.05 REFERENCES:

- A. **CODES AND STANDARDS:**
 - 1. **Electrical Standards:** Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
 - 2. **NEMA Compliance:** Comply with NEMA standards pertaining to components and devices for electric control systems.
 - 3. **NFPA Compliance:** Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 - 4. Comply with NEPA 70, "National Electric Code" for all electrical installation.

1.06 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.07 INSTRUCTION OF OWNER'S PERSONNEL: (See Section 15000)

- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

- C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Architect along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.
- D. Convey information in formal classroom session. Teachers to include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.08 WARRANTIES:

- A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion). Though some systems will be activated and functioning, warranty does not go into effect until final completion of the building and acceptance by the Owner.
- B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.09 CLEANING AND LUBRICATION: All instruments, control panel and control piping shall be thoroughly cleaned before final acceptance. Provide lubrication for all furnished equipment.

1.10 TESTING AND ADJUSTING OF SYSTEM:

- A. During the system commissioning, testing and balancing of the various building systems, have a controls representative(s) present and available to interpret and adjust controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.
- B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.

Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART II - PRODUCTS

2.01 CONTROL CABINETS: Furnish stamped steel with hinged door and locking latch control cabinets to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.

- A. Provide with surge suppressor - one per panel.
- B. Provide with 120/60/1 duplex outlet - one per panel.
- C. Provide with fuse - quantity as required.
- D. Provide with transformer 120/24 VAC quantity as required.
- E. Provide RS-232 service trunk from main panel into each ATC panel for "Laptop" computer access.

2.02 DAMPERS:

- A. In supplying dampers, instruct the sheet metal (Section 15800) workers in the proper installation of the dampers. Ductwork shall be reinforced and the damper properly supported without strain.
- B. Protect all dampers mounted in a duct system which requires special treatment.
- C. Provide damper operators with diaphragms or motors of proper size, so that the motors will operate against the static pressure of the systems. Provide each damper motor with a bracket for attaching to ductwork, building structure or equivalent. Damper motors in plenums shall be mounted on damper frames. Do not install motors in ducts. Modulating motors where indicated shall be provided with integral stops for both minimum and maximum stop.
- D. Control dampers for outside air, relief air, exhaust air, ventilating air and other dampers exposed to weather temperatures in built-up systems. Low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, bronze or teflon bearings, reinforced galvanized steel blades. Parallel action. Air leakage not to exceed 10 CFM per square foot at 4" upstream static pressure.

Johnson "Proportion-Aire" D-1200/D-1300.
Ruskin CD50
Greenheck VCD-43

2.03 CONTROL VALVES:

- A. Furnish automatic control valves required by the project. Design valves to pass the quantities of fluid at the pressure drop scheduled on the drawings.
- B. Mount all control valves with stems in the up-vertical position. Valves shall have stainless steel trim, renewable seats.
- C. Furnish valve operators with adequate capacity to operate the valve smoothly through the operating range. Provide oversized motors or operator if needed. Voltage ranges or pressure ranges shall be adjustable, the equivalent of pilot positioning for electric or pneumatic functions.

PART III - CONTROL SEQUENCES

3.01 GENERAL:

- A. Provide control systems to manage and manipulate mechanical equipment in a functional and energy conserving way.
- B. Provide control panels in the mechanical rooms, central fan rooms, with terminal block connections for interface of fans, pumps, VAV boxes, etc.

3.02 CENTRAL CONTROL AND MONITORING SYSTEM:

- A. Central Control Units shall provide for overall control and monitoring of the Building System.
- B. DDC panels shall also provide programmable timeclock functions, optimum start, and signals to ATC panels and report space temperature and condition of air handling system.
- C. Locate DDC panels in mechanical room(s) and in rooms as shown on the drawings or as directed in the field.

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3.03 ROOM/SPACE TEMPERATURE CONTROL SEQUENCES:

- A. SINGLE DUCT VAV COOLING WITH TERMINAL REHEAT: Each room/space VAV box with reheat coil shall be controlled by a digital controller fed through the central control panel, including a VAV box inlet flow sensor and outlet temperature sensor. This will allow for remote monitoring and remote changing of unit parameters.

When the room temperature is above the setpoint of the unit controller as sensed by the space sensor, the VAV box will open, the heating coil valve will be closed.

As the room temperature drops to setpoint, the VAV box modulates to its minimum. This minimum shall be fully automatically adjustable and set as called for on the Drawings.

When any room drops below setpoint, the VAV shall modulate open the heating water valve and the box damper to maintain temperature setpoints.

3.04 CABINET HEATER:

- A. Upon a drop in temperature, a DDC wall sensor through the Ddc controller opens the control valve. The aquastat mounted on the HW piping senses change in temperature. The fan starts, fan runs on one of its manually selected speeds.

3.05 SMOKE/FIRE DAMPERS:

- A. When the fire alarm goes off, every smoke/fire damper closes. When the fire alarm shuts off, they open.
- B. The damper motors shall be pneumatic or electric to match existing.

END OF SECTION 15955

SECTION 15960 - PNEUMATIC CONTROL SYSTEMS
(Compressed Air System for Damper and Valve Actuators Interfaced with DDC Functions Only.)

PART I - GENERAL:

- 1.01 RELATED DOCUMENTS: See Division 15 - "Mechanical Control Systems".
- 1.02 SUMMARY:
 - A. Pneumatic control functions and systems indicated on the drawings and specified herein.
 - B. Complete interrelationships with electric-control systems, automation systems and mechanical equipment.
- 1.03 QUALITY ASSURANCE: See Division 15 - "Mechanical Control Systems".
- 1.04 SUBMITTALS: See Division 15 - "Mechanical Control Systems".
- 1.05 DELIVERY, STORAGE AND HANDLING: See Division 15 - "Mechanical Control Systems".
- 1.06 INSTRUCTION OF OWNER'S PERSONNEL: See Division 15 - "Mechanical Control Systems".

PART II - MATERIALS AND METHODS - PNEUMATIC SYSTEMS:

- 2.01 COMPRESSED AIR SUPPLY:
 - A. Connect to existing building control air system.
 - B. Isolation Valves: Zone the air supply by for this area to allow testing and maintenance by area. Clearly identify valve locations on plan.
- 2.02 COMPRESSED AIR SYSTEM:
 - A. Use hard copper piping, wrought copper fittings, solder joints, or
 - B. Use fire rated virgin black polyethylene tubing, 2000 psi tensile strength, with vermin resistant treatment, with barbed brass fittings.
 - C. In concealed locations above lay-in ceilings fire-rated polyethylene tubing installed without conduit. Install parallel to building walls.
 - D. In all other building areas i.e. electrical rooms, mechanical rooms, above 'hard' ceilings, within walls, etc., all control tubing shall be installed in conduit cabletray, gutter, cabinet or other engineer approved protective enclosure.
 - E. Piping shall be run square with building construction, securely attached to structure. Avoid pockets. Sleeve pipe passing through walls. (To include grommet protection at sheet metal walls.)
 - F. Provide 1-1/2 diameter gauges at all points in the system where controls modify an air signal.
 - G. Test air system at 60 psi for 24 hours.
- 2.03 AIR PRESSURE GAUGES: 0-30 psig scale range; 1-1/2" dial for inside panels and at devices, 3-1/2" dials for panel face indication.

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PART III - INSTALLATION

3.01 INSTALLATION OF PNEUMATIC CONTROL SYSTEMS:

- A. GENERAL: Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and details shown on drawings.
- B. CONTROL AIR PIPING: Accessible tubing is defined as that tubing run in mechanical equipment rooms; inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in pipe chases, or suspended ceilings with easy access. Inaccessible tubing is defined as that tubing run in concrete slabs; furred walls; or ceilings with no access.
 - 1. Provide copper tubing with maximum unsupported length of 3'-0", for accessible tubing run exposed to view. Polyethylene tubing may be used in lieu of above, when run within adequately supported, rigid enclosure, such as metallic raceways, EMT, or PVC pipe. Terminal single-line connections less than 18" in length may be copper tubing, or polyethylene tubing run inside flexible steel protection. Accessible tubing run in concealed locations, such as pipe chases, suspended ceilings with easy access, etc., may be copper or polyethylene bundled and sheathed tubing.
 - 2. Provide copper or polyethylene tubing for inaccessible tubing, other than in concrete pour. If polyethylene tubing is used, install in EMT or vinyl-jacketed polyethylene tubing.
 - 3. Protect copper or polyethylene tubing when installed in masonry walls or concrete pour. Provide EMT conduit in pour and extend 6" above floor or out of wall line; pull tubing through conduit after pour.
 - 4. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
 - 5. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
 - 6. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
- C. UNIT MOUNTED EQUIPMENT: Ship electric-pneumatic relays, pneumatic- electric switches, valves, dampers, damper motors to system manufacturer for mounting and wiring at factory.

3.02 CLEANING AND LUBRICATION: See Division 15 - "Mechanical Control Systems".

3.03 TESTING AND ADJUSTING OF SYSTEM: See Division 15 - "Mechanical Control Systems".

END OF SECTION 15960

SECTION 15965 - ELECTRIC CONTROL SYSTEMS

PART I - GENERAL

- 1.01 **RELATED DOCUMENTS:** See Division 15 - "Mechanical Control Systems".
- 1.02 **SUMMARY:**
 - A. Electric control functions and systems indicated on the drawings and specified herein.
 - B. Complete interrelationships with pneumatic-control systems, automation systems and mechanical equipment.
- 1.03 **QUALITY ASSURANCE:** See Division 15 - "Mechanical Control Systems".
- 1.04 **SUBMITTALS:** See Division 15 - "Mechanical Control Systems".
- 1.05 **DELIVERY, STORAGE AND HANDLING:** See Division 15 - "Mechanical Control Systems".
- 1.06 **INSTRUCTION OF OWNER'S PERSONNEL:** See Division 15 - "Mechanical Control Systems".

PART II - MATERIALS AND METHODS

- 2.01 **ELECTRICAL POWER SUPPLY:**
 - A. Obtain power from existing Division 16 panel. Furnish appropriate circuit breakers and extend conduit and wiring assigned to this division.
 - B. Furnish and install UL listed voltage reducing transformers required for this work. Size transformers to see no more than 70 percent of rated capacity at full load.
 - C. Make all electrical installations in conformance with the National Electrical Code (current edition) and in accordance with Division 16.
 - D. Use same product lines for similar devices as used by Division 16000 to result in a coherent project.
 - E. **Control Wiring**
 - 1. In concealed locations above lay-in ceilings low voltage conductor may be installed without conduit. Low voltage conductor shall be UL listed Article 725 Plenum Cable. Install the cable parallel to building walls.
 - 2. In all other building areas i.e. electrical rooms, mechanical rooms, boiler rooms, hightemp water rooms, above 'hard' ceilings, within walls, etc., all control wiring shall be installed in conduit per National Electric Code. Installation shall be square with the walls of the buildings.
 - 3. Number and code all wiring.
 - F. Use no wire smaller than 12 gauge, no conduit smaller than 3/4".
- 2.02 **VARIABLE AIR VOLUME SYSTEM CONTROL DEVICES:**
 - A. **SENSOR/TRANSMITTER:** Dwyer Series 600 with control point at 60 percent of scale range. Furnish adjustment tool, mounting hardware, tubing adapters, sensing insertion tube. Provide power supply. Mount unit in cabinet at mechanical room. Extend 3/8" minimum tubing to sensing point (both duct and reference). Deliver 4-20 ma signal to receiver/controller.
 - B. Static pressure to be brought directly into the controller for processing.

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PART III - INSTALLATION

- 3.01 CLEANING AND LUBRICATION: See Division 15 - "Mechanical Control Systems".
- 3.02 TESTING AND ADJUSTING OF SYSTEM: See Division 15 - "Mechanical Control Systems".

END OF SECTION 15965

SECTION 15970 - DIRECT DIGITAL CONTROL SYSTEMS (DDC)

PART I - GENERAL

- 1.01 **RELATED DOCUMENTS:** See Section 15955
- 1.02 **DESCRIPTION OF WORK:** The scope of work shall include all labor, material, and equipment necessary to complete the temperature control work for the entire project.
- A. The existing building utilizes a Johnson Metasys System. The control work for this project shall be fully compatible and be of the same manufacturer.
 - B. The Contractor under this heading shall furnish and install a complete direct digital control and pneumatic automatic temperature control system as specified for all items indicated on the drawings and described hereinafter including sensors, switches, relays, thermostats, control panels for instruments.
 - C. Local Application Specific Controllers (ASC) and Network Control Unit (NCU).
 - D. Adjustment and validation of control system. Instruction of Owner's representative on maintenance and operation of control equipment.
 - E. Composite pneumatic and electric diagrams showing interlocks between equipment furnished under this and other sections.
 - F. Remote Monitoring and Control Communications capability through direct communication to the Contractor furnished and installed Metasys Central Operators Workstation.
 - G. This system shall include but not be limited to controls and equipment as hereinafter specified.
 - 1. Variable Air Volume Boxes
 - 2. Miscellaneous - Cabinet Heaters
 - 3. ATC Control Air Piping
 - 4. Other Control Systems
- 1.03 **QUALITY ASSURANCE:** See Section 15955.
- This specification wording is based on Johnson Controls, Inc. Metasys System product line.
- 1.04 **SUBMITTALS:** See Section 15955.
- 1.05 **DELIVERY, STORAGE AND HANDLING:** See Section 15955.
- 1.06 **INSTRUCTION OF OWNER'S PERSONNEL:** See Section 15955.
- 1.07 **WARRANTIES:** See Section 15955.
- 1.08 **CLEANING AND LUBRICATION:** See Section 15955.
- 1.09 **TESTING AND ADJUSTING OF SYSTEM:** See Section 15955.

PART 2 - PRODUCTS

2.01 CONTROL CABINETS: See Section 15955.

- A. Panel mount all controllers and devices other than remote sensors and operators. Provide permanent labels, terminal blocks, etc.

2.02 POWER SOURCES:

- A. Compressed Air: Connect to existing control air system, for smoke dampers if required to match existing. Basic control remains DDC.
- B. Power Supply:
 - 1. Furnish complete power supply for all application controllers at appropriate voltage and in adequate capacity. Load power supply units to no more than 70 percent of nameplate capacity.
 - 2. Run all power wiring in conduit, neatly arranged and coordinated with other trades. Plenum rated cable may be used above fully accessible ceilings only. Securely anchor and note in organized fashion.
 - 3. Group boxes served by each power supply unit in proximity, provide permanent mounted schedule of boxes served by each power supply.
- C. Communications Conductors:
 - 1. Connect each and every new Application Specific Controller (ASC) and new Network Control Units (NCU) back to the existing Central Microprocessor with required conductors. Avoid common conduit with AC voltage or inductive loads. All in accordance with National Electric Code, conductors either plenum rated cable or installed in conduit (3/4" minimum). The LAN Network shall be twisted pair or coax.

2.03 ELECTRIC DEVICES: See Section 15960.

2.04 DIRECT DIGITAL SYSTEM CONTROLLERS (DDC):

- A. Overview: The Direct Digital Control (DDC) System is an existing LAN Networked Based system with local microprocessor-based control panel networked together.

It is the intent of these specifications to connect new systems to existing systems to create an expansion of the combined direct digital control and pneumatic control system. All "system" type control functions shall be accomplished by using software algorithms in the respective DDC. .

Individual room control of VAV boxes shall be electronic controls.

- B. General Product Description:

- 1. The Facility Management System (FMS) is existing.

2.05 NETWORKING/COMMUNICATIONS:

- A. Local Building Communication:

1. Provide additional Application Specific Controllers (ASC) connected to existing Network Control Unit (NCU) (Provide new when required for capacity, quality to be equal or better than existing) to facilitate global control decision, time scheduling of occupancy monitor of zone performance and provide for past 24 hour point history of all space temperatures.
2. Communication to local ASC's shall be 9600 baud or greater. The communication protocol for both above LAN communication shall be described in a readily available published document available to the public. Building to Building proprietary LAN communication protocols shall not be accepted.

2.06 STANDALONE NETWORK CONTROL UNITS (NCU):

- A. General: Provide a new standalone NCU panel if capacity is not adequate for this addition. Each standalone NCU panel shall be equal to or better than existing.

2.07 APPLICATION SPECIFIC CONTROLLERS (ASC):

- A. VAVR boxes shall be controlled by a stand-alone DDC controller. The controller shall include all hardware and programs.
- B. The DDC controller application programs shall reside in the DDC controller providing stand-alone control when host communication is not possible. The application program shall be maintained at the DDC controller in E2PROM. The default database, i.e., setpoints and configuration information, shall be stored in E2PROM.
- C. DDC controllers requiring the application or database to be downloaded from a host shall not be acceptable. The zone controller shall run the control application using the default setpoints and configuration even after a power failure with host disabled.
- D. Controllers integrated with pneumatic damper actuators shall be furnished with electric to pressure function modules.
1. Function modules shall have a manual/auto override selection mode with an on/off switch for binary outputs, 0-20 psi hand gradual switch for pneumatic outputs.
- E. Each Standalone NCU Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
- F. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
- G. Each ASC shall have sufficient memory to support its own operating system and data bases including:
1. Generic Input/Output Monitor & Control
 2. Control Processes
 3. Energy Management Applications
 4. Operator I/O (Portable Service Terminal)
- H. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:
1. Display temperatures
 2. Display status

3. Display setpoints
4. Display control parameters
5. Override binary output control
6. Override analog setpoints
7. Modification of gain and offset constants
8. Modified selected HVAC configuration programs and down load modifications.

Each ASC shall be able to accept nickel resistant, voltage or current input sensors.

- I. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.
- J. Application Specific Software: A pre-written ASC HVAC software program shall be provided to the owner with common ASHRAE HVAC sequences of operations for VAVR boxes. This software program shall have pre-written sequences of operations where the owner can select system designs, with prompted default values or configure HVAC ASC for generic input/output for monitor and control.

Software program shall be capable of printing out owner selected sequence of operation, setpoints, and ASC predetermined wire termination guide for each input/output point.

Prior to putting Application Specific Controller on-line in an HVAC operating environment, the application specific software shall have a commissioning mode, so the owner can simulate the control sequence through assigning default values or by actual, connecting hardware to the ASC Controller at the owner's lab or test bench.

- K. Unitary Controllers:
 1. Unitary Controllers shall support, but not be limited to, the following types of systems with prewritten application specific software:
 - a. Generic Input/Output Monitor and Control
 - b. VAVR Box
 - c. Cabinet Heaters
- L. Unitary controllers shall support pre-written software configured control strategies, or generic monitor and control for future expansion or retrofit for:
- M. Occupancy-Based Standby/Comfort Mode Control: Each Unitary Controller shall have a provision for occupancy sensing overrides. Based upon the contact status of either a manual wall switch or an occupancy sensing device, the Unitary Controller shall automatically select either Standby or Comfort mode to minimize the heating and cooling requirements while satisfying comfort conditions.
- N. Occupancy-Based Zone Lighting Control: Unitary Controllers shall provide an auxiliary binary output to serve as the interface to an associated lighting relay. Based upon the status of either an occupancy sensing device, or manual wall switch, the Unitary Controller shall provide a contact output to automatically adjust the lighting level to accommodate occupant requirements while reducing electrical consumption. Standby/Comfort (described in the previous section) and Lighting overrides shall be served by the same occupancy override input.
- O. Alarm Management: Each Unitary Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

- P. Minimum point type and quantity shall be as follows:

Analog Inputs - 6
Binary Inputs - 4
Binary Outputs - 6 or 8
Analog Outputs - 2 or 0 with 8 binary outputs

2.8 VAVR BOX CONTROLLER: (One for each box.)

- A. VAVR controllers shall support, but not be limited to, the following types of systems:

1. Single Duct with Reheat

- B. VAVR controllers shall support prewritten software configured control strategies:

1. Pressure Independent

- C. Each VAVR zone controller shall be a standalone DDC controller. The controller shall include all hardware and software required for communication with the local Network Control Unit (NCU).

- D. The control program shall reside in the VAV zone controller. The application program shall be maintained in ROM. The default database, ie. setpoints and configuration information, shall be stored in EEPROM.

- E. Each VAVR controller shall have a provision for setback, setup, shutdown, or morning warmup and cooldown.

- F. Each VAVR controller shall have a provision for occupancy sensing overrides. Based upon the contact status of either a manual wall switch or an occupancy sensing device.

- G. Communications to the local NCU shall be at least 9600 baud.

- H. Minimum point type and quantity shall be a follows:

1.	Analog Inputs	6
2.	Binary Inputs	4
3.	Analog Outputs	2 or 0
4.	Binary Outputs	6 or 8

- I. Zone Sensor: (Room Thermostat)

1. The Zone sensor shall be a Johnson Controls TE-6000 with programming jack series or equal. Sensor cover shall be a beige high impact plastic cover with brushed aluminum face. Sensor dimensions shall not exceed 3" x 4" and shall not protrude from the wall more than 2".

- a. Sensors with a no external controls shall be installed in all transient areas.
- b. Sensors with override switches shall be installed in all open work areas and multiple private office zones.
- c. Sensors with override switches and setpoints shall be installed in all single zone private offices and conference rooms.

2. Provide a mechanism for adjusting setpoint within a limited range at the sensor. Provide legend indicating the graduated scale temperature setpoints on the sensor face.
3. Provide an override switch to signal the controller when the zone is occupied.
 - a. The temperature sensor shall be a high quality, high output, wire wound nickel resistant sensor. The temperature sensing element shall be mounted under the aluminum faceplate allowing the sensor appropriate response to the zone's thermal elements. Installed accuracy shall be +1°F over a 32°F to 86°F range.
4. The zone sensor shall include a jack for connection of the service tool. To prevent unauthorized tampering and vandalism, the jack shall be mounted under the sensor's cover. The cover shall be held in place by a recessed socket head set screw requiring an Allen wrench for removal. Sensors having the service tool jack exposed shall not be accepted.

J. VAVR Box Velocity Sensing: (For Air Control Boxes - VAVR Boxes)

1. Control shall be pressure independent using velocity pressure sensing to determine flow rate. The sensor shall be a Johnson DPT-2000 or equivalent. The velocity sensor shall use pressure differential technology and operate from .02" to 6" wg. The auto reset minimum CFM shall be set by the air balancer.
2. The VAV box air flow sensing tube shall be furnished and install by the VAV box supplier prior to shipment to the project sight.

K. Air Control Box Actuator:

1. The air valve shall be positioned by a dual synchronous 3-point floating motor provided by Johnson Controls, Inc. series EDP-2040. The motor shall operate the damper from full closed to full open no faster than 4 minutes and no slower than 8 minutes. Motor gears and housing shall be metallic to insure long motor life.
2. The motor assembly shall slip over the damper shaft and lock into position using knurled set screws. Rotation shall be adjustable from 45° to 90°. The motor frame shall be mounted to the box with no more than three screws. To minimize maintenance costs over the life of the installation, the gear motor shall be a separate component. Motors which are an integral part of the controller shall not be accepted.

2.9 DAMPER ACTUATORS:

- A. Damper motors for the VAVR Boxes shall be electric direct mount actuator with a magnetic clutch to provide torque protection. Actuator shall have an adjustable rotation from 30 to 90 degrees, clockwise or counter-clockwise. The actuator shall be capable of having a one, two or six minute travel time. Each actuator shall have manual override, gear release lever.

2.10 CONTROL VALVES:

- A. All automatic control valves shall be fully proportioning with modulating plugs for equal percentage of linear flow characteristics. The valves shall be sized by the control manufacturer and be provided with actuators of sufficient power for the duty intended. Valve body and actuator selection shall be sufficient to handle system pressure and shall close against the differential pressure liable to be encountered on the project.

- B. Where required by the sequence of operation, valves shall be capable of being sequenced either with other valves or other pneumatically actuated devices. Where such sequencing is required, the actual spring range, when adjusted for spring shift, shall be such that no overlapping occurs. In the event that spring shift causes an overlap, a pilot positioning operator shall be furnished.
- C. Small Valves - 1/2" Through 1": Valves shall be constructed with a cast brass body and screwed ends. Trim shall consist of a removable cage providing valve plug guiding throughout the entire travel range. A stainless steel stem shall be provided. Bonnet, cage and the stem and plug assembly shall be removable for servicing. Actuator shall be cast aluminum with spring return position operated by synthetic rubber diaphragm. Body rating shall be 400 psi at 150°F. Body rating shall also meet or exceed ANSI B16.5 Class 250.
- D. VAV Reheat Valves: Valves actuator shall be electric with either proportional or incremental control. The valve body shall be as indicated under Item C above.

2.11 SENSORS:

- A. Temperature sensors shall be of the thermistor (PTC) nickel wire, or silicon type with a high resistance change versus temperature change to insure good resolution and accuracy. Sensors shall be available for room, duct or wall mounting. Sensors shall connect to remote controller by means of a two-wire unshielded cable. Room type sensors shall be available with built-in setpoint potentiometer and programming jack. Sensors shall be available in various ranges to properly suit the application. Johnson Controls Inc. TE-6000 series.
- B. Duct-mounted averaging type temperature sensor shall utilize a nickel resistance sensing element incorporated in a copper capillary of 27 feet. The sensor shall vary the output voltage with a change in temperature. Sensor shall connect to the remote controller by means of a three-wire unshielded cable. Johnson Controls Inc. TE-6000 series.
- C. Differential pressure sensor shall vary the output voltage with a change in differential pressure. The sensor shall connect to the remote controller by means of a function module kit. Use 0-3 WC for duct static and 0-.3" WC for building static. Sensor accuracy shall be plus or minus 2% of the span. Reference sensor to outside for duct static control.
- D. Outdoor air sensor shall be of the PTC silicon, nickel or RTD type with a high resistance change versus temperature change. Sensor shall be available for outdoor or duct mounting. Sensor shall connect to remote controller by means of a two-wire unshielded cable.

PART III - EXECUTION

3.01 SYSTEM ACCEPTANCE:

- A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Owner requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

- B. Field Equipment Test Procedures: DDC controls panels shall be demonstrated via a functional end to end test. Such that:
1. All output channels shall be commanded (adjust, etc.) and their operations verified.
 2. All analog input channels shall be verified for proper operation.
 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displaying value.
 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
 6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
- C. Central Workstation Test Procedures: The Central Operators workstation test procedures shall be as follows:
1. Communication with each DDC control panel shall be demonstrated.
 2. Operator commands will be explained and demonstrated.
 3. Control sequences shall be demonstrated for proper operation.
 4. All available system reports and logs shall be demonstrated at the system workstation.
 5. Correct system start-up and shutdown procedures shall be demonstrated.
 6. All controllers shall be demonstrated to operate in a standalone mode.
- D. As-built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 as-built drawing sets, together with AutoCad diskettes to the Owner.
- E. Operation and Maintenance Manuals: Submit four copies of operation and maintenance manuals. Include the following:
1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
 2. An operator's manual which will include detailed instructions for all operations of the system.
 3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
 4. A programmer's manual which will include all information necessary to perform programming functions.

5. A language manual which will include a detailed description of the language used and all routines used by the system.
6. Flow charts of the control software programs utilized in the DDC system.
7. Flow charts of the custom software programs utilized in the DDC system as approved.
8. Complete program listing file and parameter listing file for all programs.
9. A copy of the warranty.
10. Operating and maintenance cautions and instructions.
11. Recommended spare parts list.

3.02 WARRANTY:

- A. Upon completion of the project as defined either by acceptance of the building by the Owner or by beneficial use of the equipment by the Owner, a warranty period of one year shall commence. The warranty shall consist of a commitment by the Automatic Temperature Control Contractor to provide at no cost to the Owner, parts and labor as required to repair or replace such parts of the temperature control system that prove inoperative due to defective materials or installation practices. This warranty expressly excludes routine service such as filter cartridge replacement, compressor lubrication or instrument calibration.

END OF SECTION 15970

SECTION 15995 - SYSTEM COMMISSIONING, TESTING AND BALANCING

PART I - GENERAL

1.01 GENERAL CONDITIONS:

- A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.
- B. System commissioning and startup of the mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors with the participation of the Electrical Contractor related to electrical work and the General Contractor related to general construction items.
- C. Testing and Balancing shall be the responsibility of the Mechanical Contractor under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.02 SYSTEM COMMISSIONING - EXTENT OF WORK:

- A. The work required by this section includes but is not necessarily limited to the following:
 - 1. The pre-startup inspection of all systems and subsequent correction of any incorrect items.
 - 2. The initial first run inspections.
 - 3. System operations inspection.
- B. The intent of this work is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing.
- C. Repair, replacement or adjustment of each item shall be performed by the installing contractor.
- D. Involves all new construction and those elements of existing construction which are affected by this project.

1.03 TESTING AND BALANCING - EXTENT OF WORK:

- A. This work incorporates a confirming checkout of construction work, an individual component activation and an overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.
- B. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.
- C. Conduct and participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.

- D. Involves all new construction and those elements of existing construction which are affected by this project.

1.04 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

- A. Representatives of the General Contractor, Mechanical Contractor, etc., and Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project.
- B. Balancing shall be done by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved firms to do this work are Barnett, Inc., Payson, Utah, or BTC Services, Salt Lake City, Utah or Certified Testing and Balancing, Inc, Riverton, Utah.
- C. The balancing work including air and hydronic portions shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.
- D. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.
- E. After all tests and adjustments are made a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish four copies of the report.

PART II - EXECUTION, SYSTEM COMMISSIONING

2.01 PRE-STARTUP INSPECTION:

- A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.
- B. All pertinent items shall be checked, including but not necessarily limited to the following:
 - 1. All systems properly filled.
 - 2. Fire dampers and smoke dampers properly installed and linked. Access doors provided for every damper.
 - 3. All controls have been connected and verified.
 - 4. All valves, dampers and operators are properly installed and operating.
 - 5. All ductwork is installed and connected.
 - 6. All other items necessary to provide for proper startup.

2.02 FIRST RUN INSPECTION:

- A. Recheck all items outlined in pre-startup inspection to insure proper operation.
- B. Check the following items:
 - 1. Excessive vibration or noise.
 - 2. Loose components.
 - 3. Initial control settings.
 - 4. Control system is properly calibrated and functioning as required.
- C. Correct all items which are not operating properly.

2.03 SYSTEM OPERATION INSPECTION:

- A. Observe mechanical systems under operating conditions for sufficient time to insure proper operation under varying conditions, such as day-night and heating-cooling.
- B. Periodically check the following items:
 - 1. Strainers.
 - 2. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.
 - 3. Control operation, on-off sequences, system cycling, etc.
 - 4. Visual checks of water flow, seals, packings, safety valves, operation pressures and temperature.
 - 5. Dampers close tightly.
 - 6. Valves close tightly.
 - 7. System leaks.
 - 8. Proper combustion of fuels.
 - 9. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

PART III - EXECUTION - TESTING AND BALANCING

3.01 TOTAL MECHANICAL SYSTEM BALANCE:

- A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.
- B. Prior to beginning work, a written description of the anticipated sequence of action shall be submitted to the Architect/Owner for review and comment.

- C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Architect of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.
- D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Architect of any work required by the contract which is not being performed adequately. This is in addition to the regular inspection efforts of the Architect and Engineer. Particularly note needed valves, dampers, access doors, thermometers, pressure gauges, belts and drives, diffuser styles, strainers and filters, etc.

3.02 AIR SYSTEMS BALANCE:

- A. Before any adjustments are made, check the systems for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Adjust all fan systems, major duct sections, registers, diffusers, etc., to deliver design air quantities within +5%. Individual air outlets, when one of three or more serve a space may have a tolerance of 10 percent from the average. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed check motor amperage with the filters clean.
- B. Adjust supply, exhaust and recirculation air systems towards air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC and/or SMACNA for such work.
- C. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system.
- D. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.
- E. Verify the function of all Variable Frequency Drives and related controls.

3.03 HYDRONIC SYSTEMS:

- A. Before any adjustments are made, clean strainers, check temperature control valve operation, check pump rotation, adjust pressure reducing valves, etc.
- B. Using system flow meters, pressure gauges, and/or contact pyrometer, adjust the quantity of fluid handled by each pump and supplied to each coil, piece of radiation, heat exchanger, etc., to meet design requirements. Use proportional balance techniques to minimize system pressure requirements.

Remove and trim pump impellers where throttling exceeds 10% of adequate flow.

- 3.04 CONTROL SYSTEMS: The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

3.05 MISCELLANEOUS:

- A. Observe and note all furnished thermal overload protection in the data sheets. If thermal overload protection is incorrect, the trade which furnished the overload devices shall furnish and install the correct size overload protection devices. It shall be the responsibility of the balancing firm to confirm that proper overload protection has been installed at the completion of the job.
- B. Measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.
- C. All balancing devices, i.e. dampers and valves, shall be clearly marked as to the final balanced position. Plug all test holes, replace access doors and belt guards.
- D. Upon request, based on perceived need, make 24-hour space temperature recordings. Any required rebalance of the system shall be performed without additional cost.
- E. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected specifically or at random by the Design Engineer. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing.

3.06 REPORT:

- A. Provide a bound report in four copies containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.
- B. Provide equipment data sheets listing make, size, serial number, rating, etc. of all mechanical equipment including fans, air controllers, pumps, motors, starters and drives. Operating data shall include rotational speed, inlet and outlet pressures, pressure drop across filters, coils, and other system components, pump heads, and measured motor current and voltage.
- C. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.
- D. Hydronic balancing data sheets shall list required temperature or pressure differentials used for balancing coils, radiations, condensers, etc. Sheets shall show in comparison final as-balanced versus design values.
- E. Include a reduced set of contract drawings with outlets marked for easy identification of the signation used in the data sheets.
- F. Note any abnormal or notable conditions not covered in the above.
- G. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

END OF SECTION 15995